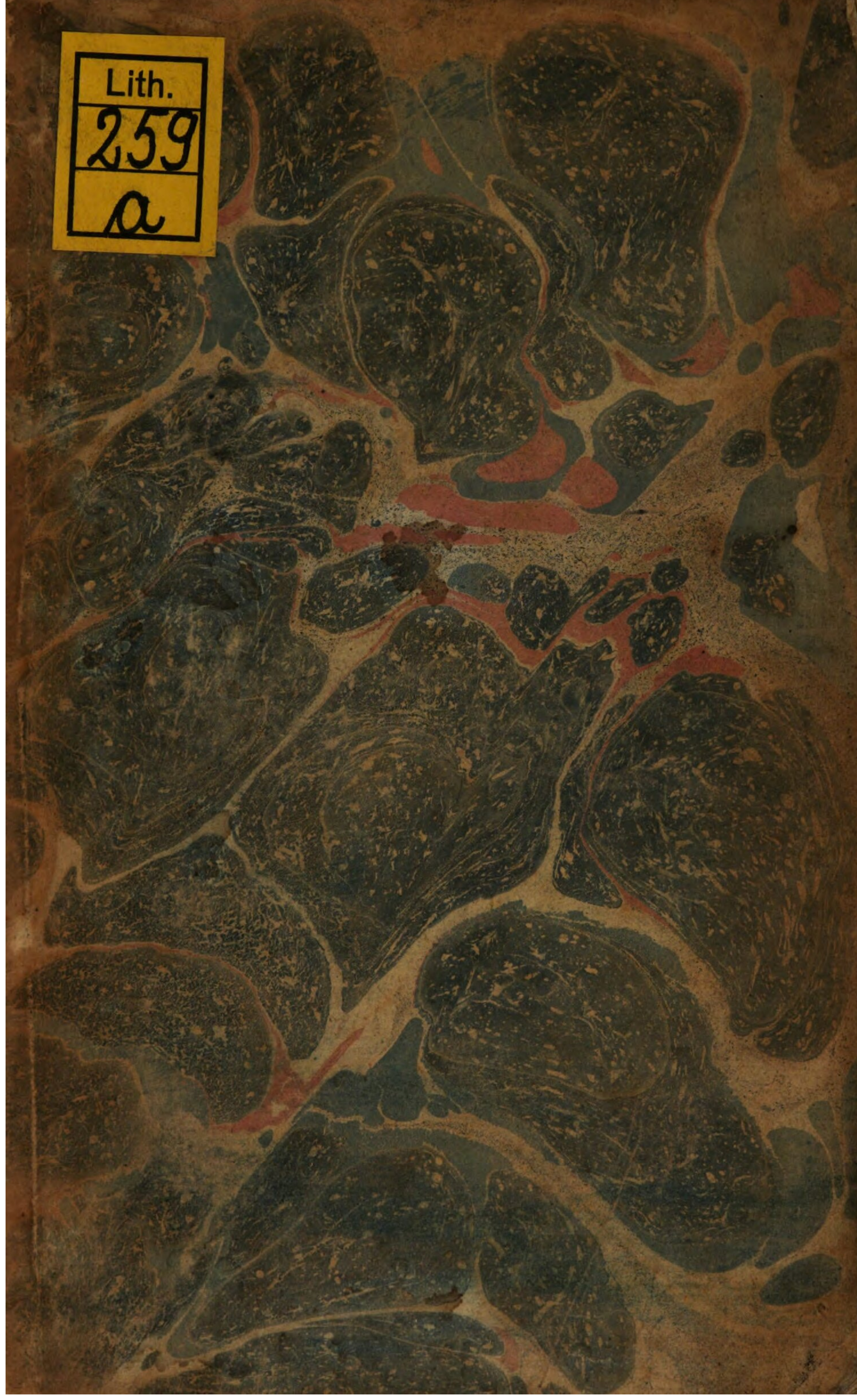


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EXTRACTS
FROM
LASIUS'S OBSERVATIONS
ON THE
HARTZ MOUNTAINS.

FROM THE GERMAN ORIGINAL.

Continued from Vol. V. p. 410.

SECTION IV.

CHAPTER III.

Of the most remarkable caverns in the calcareous range.

THESE caverns are never found quite at the foot of the mountains, but almost always at no great depth under their highest points.

They are probably nothing else than void spaces, that formerly contained soft calcareous earth, not as yet hardened into stone, which, as might have easily happened, has been washed away by water; along with which may readily

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have been carried off the materials, which had served to cement and keep together the great masses of rocks, whence would follow the tumbling down of the summits of the mountain. Wherever in this fall a large piece of rock inclined towards another, which prevented the total overthrow, the cavities so made, being afterwards covered up, produced these caverns. But, where the fragments of rocks did not incline to each other, or were too weak to resist the weight of the falling ones, the whole tumbled down, and caused on the surface of the earth the deep pits, known by the name of *earth-falls* (erdfälle) which we so frequently find in the calcareous flötz ranges.

Among these caverns that, which is called *Baumann's hole*, near Rübeland in the territory of Blankenburg, merits the first consideration. It lies in the black marble range, interwoven at times with coral plants, specimen, No. 88, about 40 toises higher up than the river Bode, on the north side; and thence the mountain rises about 20 toises more. The cavern stretches in nearly the 10th and 11th hour towards the north, and the entrance to it is rather wide.

That it has not existed from the first formation of this calcareous range, appears from the wild rocks precipitated upon each other, between which various cavities are to be found. They are so united together by stalactites, that they

they look as if they had grown together, and form a very strong arch.

The caverns, which, on account of their frightful and rough points, have not been entirely penetrated into, and probably never will, are connected together in a most wonderful manner. Curious persons usually visit only five of them, which are united with each other, this way and that way, above and below; and who can go through them without a holy shuddering! A solemn silence of death reigns in these lofty and extensive vaults, where no sound is heard, save that occasioned by the falling water-drops. Every tone emitted by a visitor is accompanied with a wide, hollow, and dull echo. What thoughts must engage a man's mind, when he reflects that he is moving under fragments of dissolution, near abysses, under rocks threatening to fall, and over abysses, covered only with precipitated masses of rocks, and that he is crawling under coral banks, where thousands of years ago rolled the billows of the ocean.

The edges of the large marble blocks are all somewhat rounded, owing to the dissolving power of the dropping water. For, where water and dampness are close upon all the edges of the marble, and in other places are constantly rendering compact the dissolved limestone in the form of concretions or stalactites, a sharp-edged
fragment

fragment may soon be rounded even into a ball, without having changed its position.* Almost every part is covered over with calcareous concretions or stalactites, which in places, where the water has flown down along the vertical or inclined surfaces, have the appearance of waves beginning to curl; but they often form all sorts of grotesque figures. The most remarkable stalactite is an insulated pillar about a toise high and six inches in diameter, which was originally generated from above, as a stalactite, by the calcareous dropping water. From the bottom below the calcareous earth contained in the water, that had dropped down, gathered and raised itself likewise into a stalactite, and thus both met in the middle and united themselves into a pillar. When struck with a hammer, it clinks like a large bell; which shews that it must be very compact and firm, as appears also from some pieces of it, that have been broken off. It is sparry, somewhat transparent, and often perfectly white in the fracture, but in some places overlaid with a yellowish brown dirty covering, which must proceed from impure water drops. This brown

* This may happen also in the firm rock, as it often appears from such bare granite stones as the, so called, hopsacks, woolsacks, &c. Accordingly we are not to believe, that every thing, which is too easily called *boulder*, has been rounded by rolling in water.

covering is often in its turn covered with white stalactite, whence, on breaking such stalactites, we frequently find various rings.

The wetter the weather, the greater the dropping of water in Baumann's hole. The earth lying above is like a sponge, which can collect water for months, to convey it gradually through the narrow passages of the cavern; how easily, therefore, can the dropping water be polluted by the impure surface water? The nearer the surface, the more frequent the dropping, and there we often find a somewhat calcareous *guhr* (gypsum terreum). In some places at the bottom the stalactite occurs also in the form of separate grains or cakes, like what is called the stone comfit of Tivoli (*confetto di Tivoli*).

It may seem singular, that the stalactites are white, whereas the marble, from whose dissolution they are formed, is for the greatest part black. But, whereas the black colour of the marble, which entirely disappears on calcination, most probably proceeds from the bitumen mixed with it, which, on rubbing the marble or striking it hard, is perceived by a smell like that of stink-stone, although rather weak, there is nothing more natural than that the dropping water could more easily draw to itself the pure calcareous earth, with which it has greater affinity, than the bitumen, which is quite heterogeneous; accordingly

accordingly these stalactites must retain the natural colour of the pure calcareous earth. In the black marble quarry at Burgberg, opposite Baumann's hole, there has been discovered a similar stalactite cavern, which, it is said, extends 50 toises into the mountain.

In the stalactite of Baumann's hole, but never in the blackish marble, are found calcined bones of animals; this is the case also in the Schärzfeld cavern. In the particular section on organized substances I shall treat more largely of the bones of animals. On the stalactite with bones, and likewise coals from wood, see the writings of the Society of Naturalists at Berlin, Vol. V. page 217. In my opinion these coals are merely the remains of fires, which were probably lighted in old times by labourers in the cavern, that were employed in removing some impediments, which rendered the examination of it difficult to the many strangers, who used to visit it. I know for certain, that a private person once made use of gunpowder, more easily to detach a quantity of bones and teeth from the broken rocks. The labourers generally made a fire every time they had to work in these cavities, were it merely for the purpose of lighting their tobacco pipes. The coals remaining after these fires, and the splinters of the bones struck off from the stones, were again flowed over by the dropping water,
and

and, by means of the calcareous earth thence deposited, were united into firm masses, in broken parts of which this phenomenon is observed.*

I now proceed to the second remarkable cavern of the calcareous range of the Hartz, viz. to that of Scharzfeld, called the *Unicorn's hole*. One descends into this zoolithe cavern, through an almost perpendicular opening, by steps cut in the rock. The passage having been widened, in consequence of a large rock having fallen off, is much narrower above than below. It stretches to the northward, and is said to extend 8000 feet into the mountain.

As the substance (*gebirgart*) in which this cavern lies, see specimen, No. 81, does not contain as much limestone as the marble rocks of Baumann's hole, that consist entirely of limestone, it is not to be wondered at, that its stalac-

* Mr. Von Trebra has been so good as to communicate to me his thoughts on this subject. He threw out a conjecture, that these coals might probably have been real bones of animals, having thus written: "I have a piece of stalactited marble from Baumann's hole, in which are fragments of weak bones, about as thick as a swan's quill, quite black, perfectly burned like a coal, and near them are bones somewhat larger, which are all white. I have placed some fragments of the black bones on burning coals, by which means they became white again."

tites

tites never form as long points as those of the other. The sides are merely overlaid with what is called rindstone (*rindensteine*), and only here and there are found large flat round pieces of stalactite at the bottom, which are generally covered with fine loose earth of a calcareous animal sort, that sometimes forms small hillocks. Out of this earth are dug bones of animals. I shall treat of them in the following section.

There are several others of these caverns in the calcareous range of the Hartz, ex. c. near Grund, in which we meet with stalactite, and crystallized calcareous spar, and also crystallized calcareous concretions (*kalchsinter*); but the greatest part of these caverns have been formed in consequence of persons having extracted from this part of the mountain the ironstone found there in nodules, and which brought along with it, as a sort of vein (*gangart*), the calcareous and remarkably beautiful black spar in various noble crystallizations.

I shall omit a closer description of the caverns, that occur in the flötz range, whereas what has been hitherto said concerning the rocky caverns is applicable also to them.

They lie for the greatest part in gypsum, and are nearly in the same state as those in the simple calcareous range, except that we find in them no stalactites, but only here and there some gypsum spar (*gypsspath*).

SECTION

SECTION V.

Of the petrifications and traces of organized substances, which are found in and on the vein mountains (ganggebirgen) of the Hartz, as likewise in the simple calcareous mountains.

I HAVE already in treating of each sort of mountain substance (*gebirgart*) indicated, whether and what traces of substances formerly organized, both of the animal and vegetable kingdoms, are found in them; but I shall now bring them together for the purpose of enlarging somewhat more on one or the other subject.

Mineralogy had been long cultivated before the characteristic features of the simple argillaceous or vein mountains were discovered, and also the peculiarity of traces of organized substances being contained in them; but at last it was agreed on, that they might be found at the surface, but not at any considerable depth: at present, however, we have by experience many additional proofs to the contrary, and in the very Hartz undeniable arguments have occurred to demonstrate, that such traces can be found at a great depth, although but seldom. In the deep mine Johannes, at Clausthal, madrepores have been found in the grey wacke 200 toises under

under the surface. In the excellent and instructive collection of Mr. Von Trebra are found, among other curiosities, fragments of unknown large sedge-leaves, which on their surface bear a somewhat stonecoal appearance; also an impression of a fructification of seed (*saamenfrucht*;) a reed-stalk channeled round, and divided into joints; a twig of the *Calla palustris*, which still plainly retains a part of the root, in the grey wacke. There are likewise ortoceratites and cornua Ammonis, which are become pyrites, from the Wolfenbüttel mine at Zellerfeld.

In the collection of Mr. Steltzner, and in the not less instructive one of Mr. Ilseman at Clausthal, there occur undeniable proofs, that even in the depths of the vein mountains (*ganggebirge*) of the Hartz are to be found remains of substances once organized, and that this range of mountains must have probably arisen from the bottom of the sea. I myself have a petrified nautilus in red jasper from the ironstone mine near Elbingerode; and the coral branch, that I found in the grey wacke between Wildemann and Lauthental (see Section III. chap. 3.) furnishes an additional argument.

I very much wished, that in each collection of specimens I could have given a more accurate and better one than the imperfect specimen, No. 21. But it must be recollected that such curiosities,

sities, as those now mentioned, are exceedingly rare. All these sorts occur singly, deep in the mountains; but all the following ones lie more together in families, and proceed, with their strata and layers, in various directions towards the surface. Thus the two layers of shells, that lie almost horizontally on the rather high point of the Rammelsberg, proceed to the surface towards the north, incline somewhat to the south, and seem to widen considerably, where in the Birkenenthal, on the Mahnberg, and over Julius hut, madrepores are found in the schistus. Between the shells of the Rammelsberg sometimes are found sulphur pyrites, copper pyrites, galena, and blende, sprinkled through them and even crossing the stone in fine threads.

The impressions usually found here are of entrochites, and principally of divers varieties of hysterochites, but which do not, like those from the Schalk, run into such long points, but into scales (*schaalen*) somewhat blunt and as if curved, and are also much shorter. There are likewise impressions of comb-muscles (*kammuscheln*) and chamites (*chamiten*), and at times broad crooked muscles, which are very like the *Solen culter*. But we find no where any trace of the natural scales of these muscles, as are not unusually found in the stratified mountains; there is nothing but stone-kernels (*steinkerne*) and impressions, between

between which those scales have been destroyed, so that between the stone-kernel and the impression there is an empty space, which accurately determines the thickness of the former muscle scales. But whereas every shell of all sorts of shellfish is differently formed on the outside from what it is inside, accordingly, on the destruction of the muscles, the stone-kernels and impressions, or rather the internal and external impressions of the destroyed muscles must necessarily be very different from each other. It is worthy of remark, that entrochites are sometimes found lying on the stone-kernels of hystero-lites.

These substances are found likewise in the Schalk, but with the already observed distinguishing marks of hystero-lites, whereby they can be always distinguished from those of the Rammelsberg. In both places we sometimes find, in the disintegrated stone, very plain fungites or coral fungi, *madrepora*, *turbinata*, *fus-tigata*, &c. In their present state they are likewise of a calcareous nature, and, when not too much decomposed, strongly effervesce with nitrous acid, by which also they are discovered in the undecomposed stone, when the eye cannot distinguish them from the natural stone, which bears the same colour with them and often gives sparks with steel.

I now

I now pass to the very remarkable remains of a substance formerly organized, I mean, to what are called screw-stones, which have been found in the Hüttenröd forest and in Kuhbach iron-stone-mine at Rübeland, and also, as great rarities, in the sandstone of the Kahlenberg and Krohnsfeld. In the former place they are found as layers, or rather in a quartzous and jasper-sort kind of vein of the ironstone vein, that courses between the schistose and calcareous ranges. The screws themselves are of a quartzous nature, but yet often in a state, in which they are near their total dissolution. From the specimen, No. 95, it will be seen, that these bear a great likeness to a screw; but upon more accurate consideration it will appear, that the word *screw* must not in this case be taken in its most precise sense. For the, so called, cutting screw-veins (*schraubengänge*) form no serpentine line around a cylinder, but are all parallel pieces mostly round, and sometimes oval, which sometimes form a right angle with the axis of the cylinder, and are sometimes placed obliquely. Each piece, which is very seldom more than six Parisian lines in diameter, form on both its surfaces a *glorie*, the rays of which run out sharp from the centre. The cylinder, on which these pieces rest, is often scarcely half a line in thickness, but at times somewhat thicker,
and

often composed of five parallel thin cylinders standing very close to each other, which in their points of contact run one into another, so that the cylinder, on its being broken, forms a pentagon star, round which the piece of the, so called, screw-vein forms a *glorie*; sometimes the pieces themselves present a pentagon appearance.

Two pieces are often found near each other, as if in pairs, so that ex. c. the space between these two pieces is somewhat greater than that between the following ones, and so it goes on alternately. The length of the screws is very various; I have never seen any of them more than an inch and a half long; they usually rest in cylindrical holes, quite disengaged all around, and are fastened to the stone only by the two ends of the cylinder. In the screws, that are not too much broken and decomposed, the greatest space between the pieces and the cylindrical holes or mantles (if I may be allowed to call them so) is the fourth part of their diameter; the more the pieces are broken, the greater consequently is the space between the mantle and the pieces, which are often so much broken, that we sometimes find but very weak or no traces at all of these pieces on the cylinder, or stalk, or spindle (call it as you will); and sometimes the whole is reduced to dust.

dust. Yet the basis, on which the cylinder stands, or has stood, always retains the circular impression of a *glorie*, which is nearly as large as the inner diameter of the mantle. This mantle has usually, within, a weak and dull impression of the pieces corresponding to it, so that one can plainly see, that between what is called the screw and the matrix stone (*muttergestein*) which forms the mantle around it, something must have been lost, which was more soluble in acids than the quartzous matrix stone and the screw, which is homogeneous with it.

The number of these pieces, that rest on a one-inch long cylinder, is not the same. I have often found, that a screw of half an inch in diameter had fifteen pieces on a length of one inch, whilst another of three lines in diameter could reckon as many; in general it may be laid down as a rule, that the number of pieces, on the length of an inch, is in the proportion of four to three, when the proportion of the screw-pieces is as one to two, that is, when two screws are each one inch long. The pieces of one will be three lines in diameter, those of the other, six; consequently the former will have sixteen pieces, and the latter twelve.

We usually find in the stone, specimen 82, impressions of suns, or *glories*, which must be taken for impressions of entrochites; but these
are

are nothing else than single pieces of what is called screw-stone; for I have sometimes found screws, particularly in the Birkenthal, not far from the Ocker, so very short, that there was only one piece on the cylinder; nay, I have found some in such a state, that the sunform impressions had between them no piece at all, but merely the common narrow interval between two neighbouring pieces along with the little cylinder.

If these substances be parts of the rays of the sea-stars, for which they, as well as entrochites, and likewise screw-stones, are held by some persons, it is still very remarkable, that in the stone, No. 99, which, besides some cha-mites and terebratulites, consists almost entirely of entrochites, there are no real screw-stones; a close affinity is easily perceived between them, and, as a quantity of screw-stones has passed through my hands, I have been able to compare them several times with entrochites. A mere accident has thrown in my way a couple of specimens of the undecomposed and unbroken stone, in which the, so called, screws are usually found. To my great satisfaction I discovered from them, that the little holes, which are usually found in this quartzous stone after disintegration, were all filled up with white calcareous spar. I observed in them a number
of

of real entrochites, and among these a rather large one, the cylinder of which is half a Parisian line in diameter. It exhibits even the rings, which, when a little above treating of the so named mantle of the screw, I have called dull impressions of the pieces corresponding to them. On the application of nitrous acid, I found to my great astonishment, that in every axis (*achse*) of these calcareous sparry entrochites there was sticking such a quartzous screw as I have now described. The entrochite becomes totally dissolved in the nitrous acid, and its quartzous axis, or what is called the screw, remains uninjured.

It is then exceedingly probable, that these screws are nothing else than the stone-kernels of entrochites; but it is still a very remarkable, and almost inexplicable circumstance, that, of one and the same organized substance, one part assumes a calcareous, and another a siliceous nature, and that both parts again are enclosed in a stone of the siliceous kind. If the entrochites themselves be considered as the flesh, and their screw-form spindles as the bones, one might perhaps think, that the harder substance would be more apt to receive the fluid siliceous earth than the softer one; but, I must confess, I find such causes of doubt and uncertainty, that I must rather wonder at the phenomenon

than say any thing about it. Every one will agree with me, that calcareous marine substances with quartzous entrails, usually enclosed in a quartzous stone, are a very remarkable and singular phenomenon.

As to the rest, the petrifications of the simple calcareous range are for the most part coral shrubs and coral sponges, zoophytes and lithophytes, madrepores and millepores, and sometimes retipores, all of which become visible only after the disintegration of the stone, or by polishing it. All the petrifications, that occur in the simple range, can be very easily distinguished from those of the flötz range, in which many of them are not to be found. I shall treat, in a separate chapter, of the petrifications of our flötz mountains.

I may now add a few words concerning the bones and teeth, which are found in Baumann's hole, and in the Unicorn hole at Scharzfeld. And first I shall say, that I fully coincide with the Jena Reviewers, year 1787, No. 175, that there are no petrified bones or teeth in the Hartz. It is true, that a person might at first be tempted to believe, that the teeth, found in the Unicorn hole, are petrified. The enamel, which is quite entire on the teeth, that have suffered but little from disintegration, renders this at first in some measure credible; but we need only
break

break one of them to be convinced, that it is not stone, but bone.

The bones found in those caverns are (with the exception of the teeth, which, owing to their being of a firmer substance, could better resist destruction) for the most part broken, and it is an extraordinary circumstance to find any of them entire, so as to be able to deliver an opinion on their original form. The skull of a bear, which Counsellor Blumenbach possesses, is a real treasure as to the natural history of Baumann's hole.

On comparing divers teeth, that have been found in the Scharzfeld cavern, it appears that they belonged to no other than carnivorous animals, and most probably bears. Mr. Blumenbach, of Göttingen, likewise looks upon them as remains of bears, and similar wild beasts. They did not belong to any animal of the feline kind, whereas the fore-teeth are not pointed. Compared with those from the Muckendorf cavern in the territory of Bayreuth, they are found to be exactly of the same kind, except that the latter are in a better state of preservation, and not so much calcined. Animal recrement (*animalische erde*) cover also the bottom of the Muckendorf cavern, but are purer *there*, and less mixed with heterogeneous substances.

As to the usual question, how did these bones

get into those places, I think it is very easy to answer it, without recurring to the deluge. We should, indeed, have recourse to great revolutions and floods, were they remains of animals of hot climates, or of extinct species of animals, or if they lay in the very mass of stone. But, since after accurate researches nothing of this sort is found, and these bones appear sticking only in earth and stalactites, but never in the rocks, they must be considered as nothing else than remains of wild beasts, which formerly, when Germany was more woody, less peopled, and had fewer habitations, than at present, took up their residence in those caverns. The thing explains itself. Bears and all sorts of similar beasts of prey generally inhabit caverns; and who can tell, what multitudes of them may have died in them during the thousands of years, that those animals retained the undisturbed possession of those wildernesses? Who knows but that they fled, in great numbers, from the flötz tracts of the extensive region all around, at times of great floods, towards the Hartz, which overtopped them like an island?

SECTION

SECTION VI.

OF THE FLÖTZ MOUNTAINS, THAT SURROUND
THE FOOT OF THE HARTZ RANGE.

CHAPTER I.

*Flötz mountains and their divers layers, from
the mound-earth (dammerde) to the deadlier
of the copper-slate flötz.*

IT is unnecessary to treat of the peculiarities of flötz mountains, as they have been sufficiently described by Counsellors Lehmann* and Gerhard.† I shall, therefore, premise only what regards those, that surround the Hartz.

The North sea, and the Baltic are to the northward of the Hartz, and begin at $53^{\circ} 55'$, or 54° N. L. From these points the flötz range begins to rise, yet in such a manner, that all the waters of the Hartz flow into the North sea by the Elbe and the Weser. Accordingly whoever would wish to describe the spreading of all the

* Dr. J. G. Lehmann's *Versuch einer Geschichte von Flötzgebirgen*. Berlin, 1756.

† Gerhard's *Versuch einer Geschichte des Mineralreichs*. Berlin, 1781.

the horizontal strata as far as the simple Hartz range, should begin from the coast of the North sea; but this would be too extensive a subject for this place. I will therefore but travel directly from the N. sea to the Hartz, and there direct my principal view to the flötz layers, that spread out at the foot of that range.

The North sea and the Baltic undoubtedly covered, at a certain period, all the main land to the foot of the Carpathian mountains, the Riesen chain (in Bohemia), the Erz, or metallic mountains of Saxony, the Saalfeld and Thuringian chain, and the ridge, which stretches through Hesse as far as Bonn, through the Palatinate, and so on through Lorraine to the very Pyrennees.

Out of these waters, in like manner as the countries on the other side of the mountains now mentioned, was seen starting up the Hartz, as far as it is coloured on the map, like an island, which must have been deposited, thousands of years earlier, from a much higher body of water.

On the way from the North sea to the Hartz the whole country is at first, for the greatest part, level sandy ground, yet not entirely without elevations, here and there somewhat argillaceous, and in some places thickly covered with turf-moor, under which there is usually clay,
which

which is covered with sand. At N. L. $52^{\circ} 30'$ near Hanover, the turf-moor ceases, and a calcareous soil (which on the way hitherto occurs only in one single spot near Lüneburg*) succeeds in its stead. Going from Hanover, somewhat farther to the south, that is, to near the Hartz, we find, indeed, more considerable sandstone ridges, which stretch out under the calcareous flötz-range, and likewise belong to the flötz class, but which must necessarily be of much longer standing than the calcareous foreland placed upon them, whereas thick strata of stone-coal, and several of them one over another, lie at its bottom, and between the sandy and calcareous ranges.

These sandstone ridges are of rather considerable extent, and surround the Hartz mountains, in some places at a greater, and in others at a smaller distance, on all sides, and are often lost under the superincumbent calcareous range, under which, unexpectedly, they often appear

* The calcareous district near Lüneburg consists for the most part of gypsum, from which flow out very abundant salt springs. In a crevice of the gypsum rock there was found, in the year 1787, a mineralogical curiosity, viz. cubical sedative-spar crystals, as hard as pebbles, which, by the bluntings of their edges and corners, form a substance of 26 sides. See Westrumb's Phys-Chem. Dissertations, Part 5, and the Transactions of the Naturalists of Berlin, vol. 9.

appear again. About five or six (German) miles to the south-west of the Hartz, (near Dransfeld) both the one and the other range has been broken through by a volcano now extinguished.

In the vicinity of the Hartz the alternation of the strata constantly becomes more frequent, and the layers are less thick, as partly at the precipices, and partly from their natural juttings out, a person can clearly perceive, so that one sees how the simple vein-range of the Hartz rises like a kernel from the scales (*schaalen*) of the flötz ridges, that surround it. More plainly we see, in mining for copper slates (*kupferschiefern*), the different flötz layers cutting each other, a very accurate description of which is given in Gerhard's History of the mineral kingdom, and in several other works.

I have not been able to render the alternation of the flötz mountain substances sufficiently visible, by means of colouring, on the map; for where one sort loses itself in some places, for, a considerable extent, under another, or under the mound-earth (*dammerde*), a clear view of it could not be given. Whatever, therefore, is flötz-range I have left white; but I have pointed out here and there the principal substances by certain marks, without accurately denoting

denoting their boundaries; and that, I think, is enough.

Of all the flötze, that stretch out nearest to the Hartz, the sandstone one is the uppermost;* and accordingly with it I shall commence the description of those, that surround the Hartz, thus proceeding from the younger flötze to the older ones. This sandstone is of various hardness, colour, and mixture. It forms, particularly in the territory of Blankenburg, entire hills, hillocks, and insulated grotesque cliffs, among which the Teufelsmauer (*Devil's wall*) at the back of the Heydelberg is singularly beautiful. It consists of a series of large broken sandstone crags hanging one upon another, which are certainly connected with the sandstone mass, that forms the hill. The wind, weather, and rain have probably stripped them of the loose covering sand, into which these same agents had by degrees reduced the rocks, so that the hardest parts alone of the sandstone masses have been able hitherto to resist their destructive power. This is probably the history of all these sandstone cliffs. I could adduce several arguments to this purpose, among which the hillocks of sand collected by the wind at the foot of

* The calcareous flötz ridge near Hanover is in reality the highest, but it is too far from the Hartz to be taken into consideration in the present description.

of cliffs, whose caverns are sometimes inhabited by men, might be sufficient.

At the foot of the Regenstein, a ruined fort, is found in the loose sand a quantity of small boulders of the siliceous kind, all of which are natives of the Hartz mountains, down to one of quartz, on which small, and for the most part crystallized, iron garnets are sprinkled, whose origin I have not been able to discover.

A brown-red ferrugineous sandstone is found in this sort of stone very abundantly in the country towards Halberstadt. And at the foot of the Regenstein, at what is called Platenberg, there are shells in the sandstone, which have been changed into calcedony, of which I will treat below in a separate chapter. Although the sandstone surrounds the whole of the Hartz, yet in no part is it found so near the vein mountains as in the district of Blankenburgh. On the south and west sides of the Hartz range it is at a greater distance from it, and, where it is nearest, is however an hour's walk distant. It first occurs, *ex. c.* at the Kiffhauser mountain, which has been accurately described by Charpentier in his Mineral Geography of the territories of Electoral Saxony, together with the petrified wood, which is found in this sandstone.

Under this huge and thick flötz of sandstone
is

is a layer of dark-grey swine-stone, which, when struck with a hammer, or rubbed against a piece of iron, or against itself, emits a disagreeable, somewhat hepatic, smell like that of horn. The specimen, No. 107, is a sample of it; its specific gravity is, 2, 744. Petrifications are but seldom found in it.

The thickness of this flötz layer is so various, that no measurement of them can be given; sometimes it forms only a thin layer, scarcely half a toise thick, through which gypsum starts out here and there in small tops or heads (*kuppen*); ex. c. between Osterode and Dorste at what is called the *Lightstone*, and in other places. But sometimes it forms, in divers varieties, entire hills, as at Scharzfeld, where it appears in close affinity with the stone, No. 84. To this sort of the varieties of swine-stone belongs the more coarse-grained, less bituminous stone, No. 108, from the foot of the Hartz range between Herzberg and Scharzfeld; specific gravity, 2, 666.

A second variety of the sorts of swine-stone is the specimen No. 109, from the sandpit near Scharzfeld; it is whitish, and, being easily friable, emits a strong smell; specific gravity, 2, 343. The friability proceeds, in my opinion, from a certain degree of disintegration; and it has often occurred to me, as if it had disengaged
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in some manner the bituminous parts, so that this specimen smells somewhat stronger than a piece broken off the solid rock at the same place. All these sorts, Nos. 81, 108, 109, 107, offer a series of the various species of swine-stone, that occur in that quarter.

The calcareous flötz, that surrounds the Hartz, and of which I am now speaking, does not in all places appear as swine-stone; but there occur some other remarkable varieties of it. In the district of Osterhagen is found a cellular limestone, which might likewise be placed among the series of the sorts of swine-stone. The irregular cells and holes of this stone are filled with what is called *Bergmilch*, (mountain milk) or *Bergmehl*, (mountain honey) mineral agaric, *calx farinacea spongiosa mollis*.*

It

* The name, *Bergmilch*, has been used in very different manners by divers mineralogists. See Wallerius's Mineral System translated (German) by Leske, Part, 1. p. 22, 23. Linnaei Regn. Min. p. 207 (*Calx gur*) and Cronstedt's Mineralogy, translated (German) by Werner, p. 16. But the substance now before us is quite different from that described by Cronstedt. I have found that, which he describes, dug out of the Schwerin Lake, and am convinced, that it is the same as that he treats of.

Another quite different sort is that, which Kirwan speaks of under the name *Lac Lunae*. He classes it under the argillaceous genus, *species 1. saturated with aerial acid*; and thus, through the want of each sort having a peculiar name, several equivocations

It is white, light, of scaly parts, sticks to the tongue, is friable to a great degree, feels very

vocations take place. Linnaeus calls it, in another place, *argillam porcellanam*, as does also Vogel. The sort now before us I have found, in some collections, denominated *terram Hopinianam sive Geranam*, and also *terram calcaream squamosam*. Gerhard calls it talc-earth (*talkerde*), of Gera; that, which I have got from Gera, is perfectly the same as the substance I am treating of. This name, however, is probably founded only on its external form; for, the description given above shows, how easily the external appearance may lead a person to take it for talc-earth. Cronstedt describes, p. 218, a talc-earth, whose external marks nearly agree with this substance; yet it seems to me, as if in Werner's additions the talc-earth was again confounded with the *farina fossilis*, No. 115, of my collection; for this is the only substance, that can be used for overlaying the paste of plaister of Paris. I do not believe that talc-earth is fit for that purpose.

Hence we see, that the name, *lac montis*, bergmilch, may be applied to various substances, and has been given indiscriminately to every thing, which was seen flowing as milk-white *guhr* from the clefts of mountains, or found in that appearance at the bottom of lakes.

The *lac montis* may accordingly belong to several classes of earths, but always ought to be distinguished by adding the name of its genus. Ex. c.

1. Argillaceous *lac montis*; this must be found in every place, where there is fine white clay, which is washed out by the rain water, that got access to it. *Argilla porcellana*. Linn.

2. Argillaceous *lac montis* saturated with aerial acid, from Halle. Kirwan. Miner. p. 80.

3. Calcareous *lac montis*, consisting of fine particles like dust, from the bottom of lakes. Cronstedt, p. 16.

4. Calcareous,

very greasy, so that it makes the skin shining, and is thereby very remarkably different from all other calcareous earths, as they make the skin rough ; it melts in water, and becomes entirely dissolved, with hasty effervescence, by means of nitrous acid. The name of *mineral sponge* (see Kirwan's Mineralogy, p. 31. German edition) seems to me the fittest for this variety of *lac montis*, or *mel montis*.

Under the calcareous substances, which on the north side of the Hartz, as an understratum of the sandstone, cover the gypsum, nowhere have I found swine-stone, or it has escaped my observation ; there is rather (besides the coarse-grained lime-stone of the Sultmerberg sometimes mixed with small pebbles, and overlaid at the
natural

4. Calcareous, scaly, glistening *lac montis*, mineral sponge. Kirwan (p. 31. Germ. Ed.) The sort, of which we have a specimen in No. 106.

5. Calcareous *lac montis*, saturated with vitriolic acid, and of a gypsous kind, *farina fossilis*. Specimen, No. 115. Cronstedt, p. 48. Wallerius, part 1, p. 28.

6. Gypsous hardened *lac montis*, which comes out with the vitriolic waters from some clefts of the Rammelsberg.

7. Calcareous *lac montis* saturated with fluor spar acid ; likewise fluor sparry *lac montis*, from the county of Marmoresch in Upper Hungary.

8. Talcosed *lac montis* ; Cronstedt, p. 218.

9. *Lac montis* containing silver, from old St. George at St. Andreasberg.

natural stone rifts with stalactite or rindstone) a grey common limestone, which, except some vermiculites, contains no traces of once organized substances; this is the sort most usually used for burning. It has in the fracture a somewhat argillaceous appearance, forms a flötz layer consisting of tables, from one to two inches thick, lying one upon another, and is altogether a large flötz of from three or four to five toises in thickness. Amidst this flötz layer are found, in the tract between Heineburg and Benzingeroode, single small tables, which, perhaps improperly, are called marble; they are of a simple yet agreeable colour, ending from gold-yellow through orange in brown-red, often streaked like veins of wood, and sometimes with small, black, imperfect, dendritic figures. It agrees very nearly with the marble from Hauterive in the canton of Berne, but is never found otherwise than in small pieces.

It is still one and the same calcareous flötz, of which I am treating and describing the varieties. Under it, likewise at the north side of the Hartz, the oolithe stone finds a place. It is particularly abundant in the district of Werningerode, usually as an immediate covering over the gypsum, but is often supplanted by other calcareous layers, and especially at Benzingeroode by a marle (*leimen*) mixed with schis-
stose

tose fragments, which there forms the covering over the gypsum. Near under the mound-earth (*dammerde*) it is somewhat greyish, but deeper down, for the most part, of a smutty brown colour, like the specimen, No. 104, which exhibits a sample of it, according as it appears in a medium between the fine-grained and coarse-grained sort, and is the most abundant in that place; specific gravity, 2, 582.*

In the quarries, where this stone occurs, I have found concave circular pieces like bowls, of from a foot to a foot and a half in diameter, in which convex lenses of the same size accurately fit. The stone has assumed this form in several layers, that lie upon each other, so that it looks as if one could raise up many of those bowls, that fit one into another. Such appearances must often occur in that tract, as they are known there by the name of cauldron, or dish-stones. Mr. Schröder† makes mention of them, and speaks of some petrifications of entire fishes,

* Mr. Kirwan calls it *Ketton-stone*, and states its specific gravity at 2, 456; it is called *Hammities*, and contains ninety per cent. of calcareous earth, and ten per cent. of argillaceous earth, so firmly united with red calx of iron as to be difficultly soluble in aqua regia; the proportion of iron is only one per cent. in this stone, and yet it sensibly colours it. The Portland-stone is said also to belong to this class.

• Description of the Brocken, p. 10.

fishes, that are met with in them, of which, however, I have found no traces.

Roe-stone is used in that district only as a bad stone for making walls, as it is but of short duration in the air, whereas the little balls, of which it consists, soon loosen and fall in upon each other. There is plenty of better limestone in the country.

Immediately under the calcareous flötz hitherto described follows gypsum, which, particularly at the south side of the Hartz, in some places rises above the calcareous range in single hillocks, but often forms entire hills, which cut off steep towards the Hartz range, and surround it there likewise as if with a wreath. They form a chain but little interrupted, four, six, ten, or even from twenty to thirty toises in height, rising up like steep cliffs. They extend from Osterode, Herzberg, &c. &c. &c. insomuch that the gypsum surrounds the whole of the Hartz. On the north side it is not nearly as thick as on the south side; but it comes closer there to the falling off of the Hartz range, and is seldom above two toises thick, but often less. At Dahle, Wiedenrode, Benzingerode, Werningerode, &c. it has been sunk into in various places, where at the going out (*ausgehenden*) it was covered

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with

with thin layers of calcareous and mound earth. The gypsum itself in those places is of no other use than in furnaces; for, where the layer is not thick, no large pieces of it can be had. That, which is dug up at Wiedenrode, takes a very good polish, and, with its reddish veins, and variously coloured gypsose-sparry spots on a white ground, looks very pretty; it is accordingly entitled to the name of alabaster.

But, whereas on the south side of the Hartz the stratum of gypsum is of such great thickness, it is natural that larger pieces of it can be had there, and that, on account of its greater hardness, it is better entitled to the name of alabaster. All sorts of statuary are made of it, particularly in the territory of Northausen; but the thickest flötze, and the largest pieces, have not always the very beautiful varieties, which are there distinguished by certain trivial names. Of the forty sorts, of which specimens are usually procured from the statuaries, I will touch upon but a few, and those the most remarkable.

The most common of all of them, and which occurs in large blocks, is what is called cloud-stone (*wolkenstein*). It is found in the Himmelsberg, in the neighbourhood of Niedersachsen, in the county of Hohnstein, and in several other parts of that tract. No. 110, is a specimen of it; specific gravity, 2, 235. In
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the cross fracture we see in this alabaster some blackish-brown undulating streaks, which, when the stone is polished according to the lamellar fracture (*auf dem spiegelbruche*)*, exhibit sometimes a very pretty cloud of divers shadings, whence probably the name of cloudstone.

The second sort is a handsome white alabaster, which is quarried about Wigersdorf; it is a pity that it does not occur in large pieces. It is very fine, and even in the fracture; specific gravity 2, 555; No. 111, is a specimen of it. It is vulgarly called *handsome maiden-stone*.

The third is a red alabaster, which, on account of its little hardness, receives no polish, and properly speaking, ought not to be called alabaster. It consists of scaly parts, and is glistening in the fracture; specific gravity, 2, 286. It is found in the district of Uftrungen, whence was taken the specimen, No. 112; it is found likewise by itself among the other species of gypsum; we find it also at the west end of the gypsum chain in the district of Lasfelde and Badenhausen.

The fourth is a dark grey alabaster with black parallel streaks, of which there is an entire mountain near Steyerthal in the county of Hohnstein. It usually breaks into tables, that

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* See Transactions, 5th Vol. Note at page 331. Tr.

lie in a horizontal layer; it seldom breaks into blocks, owing to its dark grey streaks alternating with black, as may be clearly observed in the specimen, No. 113; specific gravity, 2, 335.

From the sorts of alabaster now mentioned, which are various modifications of one and the same flötz, there proceed several very different varieties, which might probably be interesting to many amateurs, to whom I can recommend no better guide than Mr. Albertus Ritter, in his Dissertation *de Alabastris Hohnsteiniensibus*. I must, however, take notice of some few rarities. And first a bright-grey alabaster deserves to be remarked, in which are found alabaster balls entirely white, up to an inch thick; the bright-grey matrix of these balls breaks rather in a table form, and the white balls are scattered through the stone without relation to its natural separations (*ablösungen*). On splitting the tables according to their natural separations, they detach themselves from one table and stick fast to another, so that almost always a segment of the ball overtops the surface of the table. I have given a specimen, No. 114, which I have cut, so that one may clearly see even the interior of the white balls. How these balls have been produced in the alabaster, or have got into it, is a question not easy to answer; for, it seems to me scarcely credible, that

that they could have forced themselves, as round boulders, into the as yet soft mass of the grey alabaster, or that they might have been produced in certain air-holes (*blasenlochern*), which, perhaps, were caused by fermentation in consequence of the calcareous earth being saturated with vitriolic acid. Yet I should be inclined to admit the latter hypothesis, until a better and more credible one shall appear. This sort of stone is found in Johannisberg near Niedersachswerfen, whence is the specimen, No. 114. It is likewise found in the district of Steyerthal.

Another and much greater rarity is found in the district of Harzungen, under the name of snake-stone (*schlangenstein*). I have a specimen of light-grey alabaster, four inches and a half long, on which a white irregular snake-line, about the twelfth part of an inch thick, runs through a length of seventeen inches. Another similar snake-line runs at the distance of half an inch, exactly parallel to the former. What can this be? Are these snake-lines the contact marks of two alabaster tables, lying one upon the other, which had an undulating surface? This does not seem credible. When on a rubbing stone a dark colour in the form of pap is made to mix with a brighter one, I have often observed similar appearances, before the mixture
was

was fully completed; the snake-lines are probably to be ascribed to a similar operation at a time, that the mass was still pappy and fluid.

I have already, when speaking of the calcareous flötz, made mention of what is called *lac montis*, agaric mineral, and likewise of the gypsose *mel caeli*, *farina fossilis*, of which, No. 115, is a specimen. As Mr. Werner had not seen it before the publication of his new translation of Cronstedt, I shall endeavour to describe its external marks. It is white—in the form of flour, that does not grate between the teeth—without any glistening particles—feels very dry and meagre—does not, even in a dry state, get into lumps, as hair-powder does to a certain degree—is so light, that it floats somewhat on water, before it falls to the bottom, where it becomes a pap—effervesces but little with the nitrous acid, which, however, disengages nothing particular from it—when burned, is remarkably fine, and of a dazzling whiteness. This substance occurs by itself in the crevices of the gypsose mountains, and most abundantly at Bischofrode in the county of Hohnstein, where in times of heavy and constant rain it flows out like milk, and is probably nothing else than dissolved gypsum-stone.

Of the remains of organized substances, found in

in this gypsose range, I shall treat in the third chapter of this section.

On sinking into the fine copper-slate flötz, such places are, as much as possible, fixed upon, where the outgoing (*ausgehende*) of the flötz layers hitherto described is far backwards, to avoid sinking through them. As this range lies over against the Haiz chain, and rises, in many places very steep, more than 200 feet high, it is vulgarly called the *gegengebirge*, or counter-range.

This counter-range has, to the south side of the Hartz chain, as to the position of the flötz, a dip nearly parallel with the outward fall of the Hartz vein-range, and also with the inward structure of its courses; and this holds good likewise as to the succeeding flötz layers, which lie deeper down; I do not know of any exception to this rule, at least on the S. side of the Hartz. But on the N. side divers falls occur, in which the flötz layers of the natural outward roof of the Hartz vein-range, in opposite or contrary directions, and consequently rather parallel with the inward structure of the courses of the vein-range, fall from north towards south. This is the case as to the small chain of hills, which at the north side ex. c. at the Langenberg, near Drübbeck, Darlingerode, Werningerode, Benzingerode, and Heinburg, surround
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the Hartz as if with a mound, through which the streams and rivers, flowing from the Hartz, appear to have intersected the connexion of its parts.

At the Sultmerberg, near Goslar, the layers of limestone are parallel with the fall of the Hartz range, and thence spread themselves still more downwards until they push again under other flötz layers, which have their outgoings (*ausgehendes*) at a greater distance from the Hartz.

It is also worth remarking, that much more abundant vestiges of organized substances are found in the *Gegenbirge*, or counter-range, than in the flötz layers, which are sunk into for copper-slates, and in which scarcely any thing of that kind is to be met with.

Of the flötz layers under the gypsum, which cover the copper-slate flötz, I shall treat towards the end of the second chapter; at present it will suffice to refer to the numbers there mentioned, from IV. to XIII. included.

Meanwhile I must in this place describe more particularly a limestone, which in the enumeration now alluded to is marked No. V. and is called *zechstein*. The stratum of it is usually two toises thick, but is sometimes thicker, and at its *outgoings* forms entire hills, as ex. c. near the Königshütte at Lauterberg. When rubbed

rubbed, it emits a smell somewhat like that of swine-stone; and it is used in the iron foundry at the hut as a menstruum. Sometimes there are found in it small pieces of galena, which contain per cent. eighty parts of lead, and only half an ounce of silver; they are from one half to two inches thick; there occur also some crevices, up to four inches wide, filled with a somewhat darker limestone, as if with a sort of vein. But what renders this *zechstein* still more interesting, is the talcose mica, which is usually found in the fissures of the stone as if laid on, and rarely in nodules. No. 105 is a specimen of it. Specific gravity, 2, 708.

Passing over some other flötz layers, which have been fully described in other works, I now proceed to the copper-slate flötz. This flötz, which surrounds the whole of the Hartz mountains at their foot, and, with a few exceptions caused by particular circumstances, falls right, or, for the greatest part, has a parallel fall with that of the Hartz range, lies 705 Paris feet above the level of the Baltic. It is very seldom visible at the surface. In some steep precipices, occasioned by external circumstances, it appears at the surface; ex. c. from Lauterberg to Scharzfels the Oder flows along the foot of the Hartz, and seems to line that, which is properly the vein-range. But it is not until we ascend

ascend between the Försterhause and the Königshütte towards the steep flötz range, that we find the vein-range, upon which the dead-lie, and then the copper-slate flötz, 14 inches thick, with its superincumbent flötz layers lie near each other.

Mr. Werner, in his translation of Cronstedt's Mineralogy, p. 73, has given to this flötz, or copper-slate, the name of bituminous marleslate, whereas copper and metallic parts constitute the smallest portion of it. Argilla and some calx, both intimately united by bitumen (which on the rubbing and breaking of it is perceived by the smell, and renders the copper very difficult of fusion) are the chief component parts. There are sometimes clear impressions of fishes, which are very often somewhat in the state of pyrites (*verkieset*).

In the undermost layer the slate is found, in some places, strongly impregnated with pyrites, nay, consisting entirely of it; and between the slate there occur at times threads and knots of vitrous copper. But then they are no longer called slate, but flötz mineral (*flötzerze*). See Gerhard's Gesch. des Min. R. part 1. §. 72.

Under the flötz minerals is comprehended also another sort of minerals, viz. those that appear on what are called backs or turns; these backs are constantly in the places, where the flötz assumes

sumes an altered fall or dip, and must be considered as breakages, which the flötz has been subject to in consequence of great revolutions of the earth. In these breakages the copper-slate flötz is usually of a nobler kind, and they may be called veins of the flötz range, in which a richer and finer sort of minerals, such as copper pyrites, vitrous copper, galena, cobalt, copper-nickel, and sometimes mere green or blue copper-ochre are generally found.

At the long wall near Ilefeld some of these backs or turns showed at the surface the beautiful copper pyrites, that breaks out on them, and pretty looking, but in fact very bad cobalt, which usually appeared in an ochreous form; this induced some ignorant undertakers to look upon it as the real vein lying deep below, and of the sort that is found in the vein-mountains; nor did they perceive their error until having expended much money on their works, and on the building of a smelting house. The slate was too poor in mineral, and the smelting of it would not have been worth the trouble. For, the slate is not generally of the same good kind as to the proportion of mineral; and it appears to me, that the flötz, considered on the whole, is poorest at the western foot of the Hartz mountains, and that its value encreases in proportion as it extends to the eastern extremity; for, the richest

richest flötze are found in the county of Mansfeld, and in the territory of Eisleb. Nearer towards the west the flötz has been sunk into in several places, but, owing to the poor produce, no works were erected. This was the case, ex. c. at Herzberg, where some galena was found, which, however, could not cover the expence of a regular undertaking. Still farther to the west it has been found so poor, that it was, at best, like a bad sort of stone-coal.

In like proportion there appears a remarkable difference, as to richness, between the flötz on the south side and that on the north side of the Hartz. On the S. side the slate is constantly much richer than on the N. side, where it looks like bad stone-coal. This is not to be confounded with the real stone-coal flötz, which at Blankenburg, and many other places, is seen at the surface over the copper-slate flötz.

I shall now, in my description of the flötz range, go deeper down to where the deadlier is found with its various modifications, according to which it approaches sometimes to a breccia, and at other times (as in the territory of Ilfeld) to a fine sandstone, or a sort of porphyry, the next substance lying under the copper-slate flötz. As these substances are older than the copper-slate flötz now mentioned, together with its superincumbent layers, it will be proper to treat of them in a separate chapter.

CHAPTER

CHAPTER II.

Of the older flötz layers, that lie under the copper-slate flötz, and accordingly between it and the foot of the vein-range of the Hartz.

IN this place, what is called deadlier, is the first object of consideration, and I cannot give a better description of it, than that, which Mr. Voigt, of Weimar, has given in his Letters on Mineralogy, p. 16. These are his words: “When the primitive mountains existed still alone, and were enveloped in a troubled wild ocean, above which only some of their backs appeared like islands, the first operation of the water consisted in gnawing the adjoining parts of the mountains, the broken parts of which fell upon the bottom of them. Hence was derived the lowermost flötz layer, which we always find lying immediately upon the primitive range, and which is called *red deadlier*. It consisted of a prodigiously diversified collection of rounded stones, united together by means of a red, or sometimes a grey argillaceous substance, and the whole has acquired a considerable

able degree of hardness." It is, therefore, not to be wondered at, that in the deadliers there appears such a variety of divers sorts of stones, which, for the greatest part, belonged to the neighbouring primitive mountains; many of them, however, are parasitic, having been brought by the water from remote tracts. They are not always connected together, and sometimes lie quite loose at the foot of the primitive chain. Thus ex. c. in the district of Osterode there is a monstrous quantity of rounded boulders, of all sizes, mostly quartzous, but yet often parasitic, or heterogeneous to the Hartz mountains, lying immediately at the foot of the vein-range of the Hartz; and these are the same as the deadlier, or the undermost layer of the flötz range.

To describe all the different modifications of this deadlier would be too tedious, and very little interesting; but it must be interesting to be informed, that it forms entire mountains, which often rise with extraordinary steepness to the height of 688 Paris feet, and then proceed gently upwards as high as 772 feet over Ilfeld—that there are veins in it, and various other layers, in so much, that even a stone-coal flötz lies under them, at the bottom of which impressions of sedge and herbs are very clearly perceived. The view of the whole, given at
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the end of this chapter, will convey a clear idea of it.

I have, on the map, distinguished the places, where porphyry occurs, by a dark-green colour; and a considerable portion of the Hartz, in the district of Ilfeld, will be found thus coloured. A very singular sort of stone is found there, which I cannot reduce to any other class than that of the porphyrites.

Probably no objection will be made to admitting the stone, No. 74, of the collection into the class of porphyrites; it is a brown-red, somewhat corneous, argillaceous stone, with some felspar and single green serpentine-like intermixtures; in it are seldom found small iron garnets, which, however, occur in specimen, No. 74, which is from Sandlitz, near Ilfeld, where it adjoins the sorts of amygdaloid, and lies upon them. Specific gravity, 2, 641.

The nearer we proceed to the flat country, the more the stone changes, and the less does it seem like porphyrite; yet one stone loses itself so much into the other, that a person is often in doubt, what he must take it for. Thus, as No. 74 is one extreme, next to the amygdaloid, so is No. 75 the other extreme, in the neighbourhood of the flat country. At first sight, the latter will certainly not be taken for porphyrite, and yet it is so nearly allied to the
other

other stone now described, that it cannot be well called by another name. It is of a brown-red colour, rough, and somewhat sandy in the fracture, and sprinkled here and there with small white points, which are probably felspar.

Mr. Westrumb has analyzed this singular stone. I here give the result of four of his different experiments, which is as correct as any analysis can be, and as might be expected from the accuracy of so great a chymist: it is contained in the following extract of a letter of his, dated June 20, 1787.

“It consists of silex, alum earth, calcareous earth, almost metallic iron, and ponderous spar-earth (*schwerspatherde*). That the iron, contained in it, is in the form of a nearly perfect metal, I conclude from the dark-green colour, which the fossil, after its heating with alkali (*laugensalzen*), communicates to the acids.”

“Whether the ponderous earth, as spar which is united with vitriolic acid, form a component part of the mineral, I dare not determine, nor can it be determined, when a person is obliged to heat a mineral before its decomposition with alkali. This much is certain, that the earths, which it contains, are void of air—it does not effervesce with acids, loses little when heated, and at most, when heated in the air apparatus, drops a little water in the fire; and, finally, the
parts

parts separated by decomposition amount to much more than the mineral in its original state, and the longer and more it is heated, the greater the increase of the parts decomposed."

"Its specific gravity is 2,052.—Taking the proportion of component parts at 100—we have of siliceous earth———parts—71

———alum earth———Do.—19

Calcareous earth void of air—Do.— 7

Calx of iron (*Eisenkalch*)—Do.— 9, 50

Ponderous spar earth———Do.— 0, 75

Total 107, 25

"You are not surprized, that there are 7, 25 parts more than there ought to be. The earths, in consequence of the heating, received some air and water, and then the iron existed as metal, not as calx in the composition of the mineral; if this be attended to, and if we recollect that 100 grains of iron metal give 225 of iron calx, the phenomenon can be easily accounted for."

These two sorts of stone form, in the district of Ilfeld, particularly at the Herzberg, very handsome grotesque cliffs, the like of which are no where to be met with, except at the granite mountains, or at most in the simple calcareous range of the Hartz. It is a singular and very remarkable circumstance, that they

bear a close resemblance with the vein mountains, in so much that there are real veins in them. There are courses in them still more perpendicular than in the simple argillaceous vein-mountains; and it would not easily occur to any one to consider them as a flötz range, did not the stone-coal flötz lying under them, at Rabenstein near Ilefeld, and at Vaterstein near Neustadt, clearly prove them to be such. Were this not the case, a person would reckon them, and also the amygdaloid and trapp lying under them, among the older classes of vein-mountain; so easy is it to err in fixing the age of mineral substances and classing them. Who would look for a coal flötz at so great a depth under the copper-slate flötz, which appears at the long wall near Ilefeld? The outgoings (*ausgehende*) of these two flötze are, with similar dips, 4500 paces from each other; the former at the long wall near Ilefeld, and the latter at the northern limit of the range over Ilefeld, coloured green, at what is called Brandes Bach. Among the varieties and divers modifications of these two substances is also the specimen, No. 78. This is a very hard argillaceous mass, of a pale peach-blossom colour, in which are sprinkled very fine small bits of felspar, which, however, being of the same colour with the stone, are scarcely visible to the naked eye. The felspar becomes
consumed.

consumed by disintegration, and instead of it there remain the little holes, which it had occupied. This stone bears some likeness to the sort of porphyry, which Mr. Voigt has given in his Mineral Cabinet, No. 7. It goes by the trivial name of cotton-stone, probably on account of the single round spots, which are commonly red and have a yellowish edging, and at times are quite yellow. It is very difficult to determine its position and relative proportion; but this much is certain, that it occurs in a very close vicinity with the amygdaloid, No. 58. It is found at Ochsenplatz on the west side of the Netzberg in a small plain, surrounded with such substances as Nos. 74 and 75, and seems, at the bordering with the amygdaloid and trapp, to be a modification of No. 74; specific gravity, 2,298.

The mineral veins, that are found in the two masses No. 74 and 75, give iron for the most part, which may be easily supposed on account of the considerable proportion of iron, that the substance, No 75, certainly contains. There appear in it white-iron ore (*stahlerz*) according to Mr. Kirwan, fine red hematite, and crystallized ferruginous mica (*eisenglanz, eisenmann, eisenglimmer, eisenrahm*;) the iron is often very rich in brown-stone. The gang is quartz and ponderous spar; and the adjoining stone of

ascend between the Försterhause and the Königshütte towards the steep flötz range, that we find the vein-range, upon which the dead-lier, and then the copper-slate flötz, 14 inches thick, with its superincumbent flötz layers lie near each other.

Mr. Werner, in his translation of Cronstedt's Mineralogy, p. 73, has given to this flötz, or copper-slate, the name of bituminous marleslate, whereas copper and metallic parts constitute the smallest portion of it. Argilla and some calx, both intimately united by bitumen (which on the rubbing and breaking of it is perceived by the smell, and renders the copper very difficult of fusion) are the chief component parts. There are sometimes clear impressions of fishes, which are very often somewhat in the state of pyrites (*verkieset*).

In the undermost layer the slate is found, in some places, strongly impregnated with pyrites, nay, consisting entirely of it; and between the slate there occur at times threads and knots of vitrous copper. But then they are no longer called slate, but flötz mineral (*flötzerze*). See Gerhard's Gesch. des Min. R. part 1. §. 72.

Under the flötz minerals is comprehended also another sort of minerals, viz. those that appear on what are called backs or turns; these backs are constantly in the places, where the flötz assumes

sumes an altered fall or dip, and must be considered as breakages, which the flötz has been subject to in consequence of great revolutions of the earth. In these breakages the copper-slate flötz is usually of a nobler kind, and they may be called veins of the flötz range, in which a richer and finer sort of minerals, such as copper pyrites, vitrous copper, galena, cobalt, copper-nickel, and sometimes mere green or blue copper-ochre are generally found.

At the long wall near Ilefeld some of these backs or turns showed at the surface the beautiful copper pyrites, that breaks out on them, and pretty looking, but in fact very bad cobalt, which usually appeared in an ochreous form; this induced some ignorant undertakers to look upon it as the real vein lying deep below, and of the sort that is found in the vein-mountains; nor did they perceive their error until having expended much money on their works, and on the building of a smelting house. The slate was too poor in mineral, and the smelting of it would not have been worth the trouble. For, the slate is not generally of the same good kind as to the proportion of mineral; and it appears to me, that the flötz, considered on the whole, is poorest at the western foot of the Hartz mountains, and that its value encreases in proportion as it extends to the eastern extremity; for, the richest

richest flötze are found in the county of Mansfeld, and in the territory of Eisleb. Nearer towards the west the flötz has been sunk into in several places, but, owing to the poor produce, no works were erected. This was the case, ex. c. at Herzberg, where some galena was found, which, however, could not cover the expence of a regular undertaking. Still farther to the west it has been found so poor, that it was, at best, like a bad sort of stone-coal.

In like proportion there appears a remarkable difference, as to richness, between the flötz on the south side and that on the north side of the Hartz. On the S. side the slate is constantly much richer than on the N. side, where it looks like bad stone-coal. This is not to be confounded with the real stone-coal flötz, which at Blankenburg, and many other places, is seen at the surface over the copper-slate flötz.

I shall now, in my description of the flötz range, go deeper down to where the deadlier is found with its various modifications, according to which it approaches sometimes to a breccia, and at other times (as in the territory of Ilfeld) to a fine sandstone, or a sort of porphyry, the next substance lying under the copper-slate flötz. As these substances are older than the copper-slate flötz now mentioned, together with its superincumbent layers, it will be proper to treat of them in a separate chapter.

CHAPTER

CHAPTER II.

Of the older flötz layers, that lie under the copper-slate flötz, and accordingly between it and the foot of the rein-range of the Hartz.

IN this place, what is called deadlier, is the first object of consideration, and I cannot give a better description of it, than that, which Mr. Voigt, of Weimar, has given in his Letters on Mineralogy, p. 16. These are his words: “When the primitive mountains existed still alone, and were enveloped in a troubled wild ocean, above which only some of their backs appeared like islands, the first operation of the water consisted in gnawing the adjoining parts of the mountains, the broken parts of which fell upon the bottom of them. Hence was derived the lowermost flötz layer, which we always find lying immediately upon the primitive range, and which is called *red deadlier*. It consisted of a prodigiously diversified collection of rounded stones, united together by means of a red, or sometimes a grey argillaceous substance, and the whole has acquired a considerable

able degree of hardness." It is, therefore, not to be wondered at, that in the deadliers there appears such a variety of divers sorts of stones, which, for the greatest part, belonged to the neighbouring primitive mountains; many of them, however, are parasitic, having been brought by the water from remote tracts. They are not always connected together, and sometimes lie quite loose at the foot of the primitive chain. Thus ex. c. in the district of Osterode there is a monstrous quantity of rounded boulders, of all sizes, mostly quartzous, but yet often parasitic, or heterogeneous to the Hartz mountains, lying immediately at the foot of the vein-range of the Hartz; and these are the same as the deadlier, or the undermost layer of the flötz range.

To describe all the different modifications of this deadlier would be too tedious, and very little interesting; but it must be interesting to be informed, that it forms entire mountains, which often rise with extraordinary steepness to the height of 688 Paris feet, and then proceed gently upwards as high as 772 feet over Ilefeld—that there are veins in it, and various other layers, in so much, that even a stone-coal flötz lies under them, at the bottom of which impressions of sedge and herbs are very clearly perceived. The view of the whole, given at
the

the end of this chapter, will convey a clear idea of it.

I have, on the map, distinguished the places, where porphyry occurs, by a dark-green colour; and a considerable portion of the Hartz, in the district of Ilfeld, will be found thus coloured. A very singular sort of stone is found there, which I cannot reduce to any other class than that of the porphyrites.

Probably no objection will be made to admitting the stone, No. 74, of the collection into the class of porphyrites; it is a brown-red, somewhat corneous, argillaceous stone, with some felspar and single green serpentine-like intermixtures; in it are seldom found small iron garnets, which, however, occur in specimen, No. 74, which is from Sandlitz, near Ilfeld, where it adjoins the sorts of amygdaloid, and lies upon them. Specific gravity, 2, 641.

The nearer we proceed to the flat country, the more the stone changes, and the less does it seem like porphyrite; yet one stone loses itself so much into the other, that a person is often in doubt, what he must take it for. Thus, as No. 74 is one extreme, next to the amygdaloid, so is No. 75 the other extreme, in the neighbourhood of the flat country. At first sight, the latter will certainly not be taken for porphyrite, and yet it is so nearly allied to the
other

other stone now described, that it cannot be well called by another name. It is of a brown-red colour, rough, and somewhat sandy in the fracture, and sprinkled here and there with small white points, which are probably felspar.

Mr. Westrumb has analyzed this singular stone. I here give the result of four of his different experiments, which is as correct as any analysis can be, and as might be expected from the accuracy of so great a chymist: it is contained in the following extract of a letter of his, dated June 20, 1787.

“It consists of silex, alum earth, calcareous earth, almost metallic iron, and ponderous spar-earth (*schwerspatherde*). That the iron, contained in it, is in the form of a nearly perfect metal, I conclude from the dark-green colour, which the fossil, after its heating with alkali (*laugensalzen*), communicates to the acids.”

“Whether the ponderous earth, as spar which is united with vitriolic acid, form a component part of the mineral, I dare not determine, nor can it be determined, when a person is obliged to heat a mineral before its decomposition with alkali. This much is certain, that the earths, which it contains, are void of air—it does not effervesce with acids, loses little when heated, and at most, when heated in the air apparatus, drops a little water in the fire; and, finally, the parts

parts separated by decomposition amount to much more than the mineral in its original state, and the longer and more it is heated, the greater the increase of the parts decomposed."

"Its specific gravity is 2,052.—Taking the proportion of component parts at 100—we have of siliceous earth———parts—71

————alum earth———Do.—19

Calcareous earth void of air—Do.— 7

Calx of iron (*Eisenkalch*)—Do.— 9, 50

Ponderous spar earth———Do.— 0, 75

Total 107, 25

"You are not surprized, that there are 7, 25 parts more than there ought to be. The earths, in consequence of the heating, received some air and water, and then the iron existed as metal, not as calx in the composition of the mineral; if this be attended to, and if we recollect that 100 grains of iron metal give 225 of iron calx, the phenomenon can be easily accounted for."

These two sorts of stone form, in the district of Ilfeld, particularly at the Herzberg, very handsome grotesque cliffs, the like of which are no where to be met with, except at the granite mountains, or at most in the simple calcareous range of the Hartz. It is a singular and very remarkable circumstance, that they

bear a close resemblance with the vein mountains, in so much that there are real veins in them. There are courses in them still more perpendicular than in the simple argillaceous vein-mountains; and it would not easily occur to any one to consider them as a flötz range, did not the stone-coal flötz lying under them, at Rabenstein near Ilfeld, and at Vaterstein near Neustadt, clearly prove them to be such. Were this not the case, a person would reckon them, and also the amygdaloid and trapp lying under them, among the older classes of vein-mountain; so easy is it to err in fixing the age of mineral substances and classing them. Who would look for a coal flötz at so great a depth under the copper-slate flötz, which appears at the long wall near Ilfeld? The outgoings (*ausgehende*) of these two flötze are, with similar dips, 4500 paces from each other; the former at the long wall near Ilfeld, and the latter at the northern limit of the range over Ilfeld, coloured green, at what is called Brandes Bach. Among the varieties and divers modifications of these two substances is also the specimen, No. 78. This is a very hard argillaceous mass, of a pale peach-blossom colour, in which are sprinkled very fine small bits of felspar, which, however, being of the same colour with the stone, are scarcely visible to the naked eye. The felspar becomes
consumed.

consumed by disintegration, and instead of it there remain the little holes, which it had occupied. This stone bears some likeness to the sort of porphyry, which Mr. Voigt has given in his Mineral Cabinet, No. 7. It goes by the trivial name of cotton-stone, probably on account of the single round spots, which are commonly red and have a yellowish edging, and at times are quite yellow. It is very difficult to determine its position and relative proportion; but this much is certain, that it occurs in a very close vicinity with the amygdaloid, No. 58. It is found at Ochsenplatz on the west side of the Netzberg in a small plain, surrounded with such substances as Nos. 74 and 75, and seems, at the bordering with the amygdaloid and trapp, to be a modification of No. 74; specific gravity, 2,298.

The mineral veins, that are found in the two masses No. 74 and 75, give iron for the most part, which may be easily supposed on account of the considerable proportion of iron, that the substance, No 75, certainly contains. There appear in it white-iron ore (*stahlerz*) according to Mr. Kirwan, fine red hematite, and crystallized ferruginous mica (*eisenglanz*, *eisenmann*, *eisenglimmer*, *eisenrahm*;) the iron is often very rich in brown-stone. The gang is quartz and ponderous spar; and the adjoining stone of

the veins of the Netzberg is a red jasper similar to specimen No. 32. The veins are good, while passing through the porphyritic substances, Nos. 74 and 75, and unproductive in passing through the layers of amygdaloid down to the trapp, where they become good again.

Farther on from Ilefeld towards the west there are found in the Harzeburg and Möncheberg veins of brown-stone, whose *gang* is chiefly ponderous spar. Under the range of the porphyritic stone, No. 74, is found the amygdaloid* with very different varieties, at first with

* In a note on the name, *amygdaloid*, Ladius makes some observations on Mr. Kirwan's definition of it; but, as they apply not to the second, but to the first edition of that gentleman's Mineralogy, I do not think it necessary to give them here. In the same note he makes the following remarks on zeolite. "Zeolites also might be reckoned among the admixtures of amygdaloid, did they not in the sorts of amygdaloids, that contain them, appear somewhat equivocal, and often must be considered as volcanic substances. We see indeed from the Hartz mountains, that zeolite can be formed without volcanoes; therefore we are not positively to reckon among the volcanic productions the amygdaloids, which contain zeolite. Where the amygdaloid forms whole mountains in the Palatinate and Dutchy of Deux Ponts, it is, as well as that of the Hartz, not to be reckoned among the volcanic productions, but, like that and the amygdaloid of Derbyshire, among the flötze placed on the older vein-mountains. Yet in those districts of the Palatinate I have found the amygdaloid broken through by volcanoes in different places, in which similar sorts of amygdaloid are found among the lavas. But this is a matter of mere circumstances." Tr.

with weak indications, but which, as one goes farther down, become still clearer. The uppermost layer of it consists of an argillaceous sort of stone, with small, and often scarcely perceptible holes, which are generally either filled within with green earth of the serpentine kind, or have it scattered near them. At the surface it is very much disintegrated, as appears from the specimen, No. 59; it is often very ferrugineous, and is intersected by veins of ferrugineous spar (*eisenspath*). This circumstance, and the little greenness have given occasion to make some attempts at smelting it in the Electorate of Treves, where also it is found; but only a very impure and mixed metal, which for the most part is iron, has been obtained. No. 58 is an undecomposed specimen of this stone: it is from the Ochsenplatz at the west side of the Netzberg, and its specific gravity is 2,598; in this specimen the air-holes are still more plainly recognized. The deeper down, the larger these air-holes, in which are sometimes found small kidney-form lumps of calcareous spar with serpentine, and likewise some small balls of calcedony, which Wallerius calls *swallow-stones*. No. 57 is a specimen of it; it is from the Netzberg about Ilefeld; specific gravity, 2,632. When the air has destroyed the small kidney-form bits of calcareous spar, this stone acquires the fallacious appearance of a porous lava.

Still

Still deeper down the air-holes are proportionably larger, and a greater quantity of calcedony and agate appears in them, but yet in rather undetermined forms, ex. c. longish, rounded, flat little pieces, such as the specimen, No. 6.

Then follows a brown liver-colour trapp, which, on account of the regular balls of agate, &c. occurring in it, belongs likewise to the amygdaloids. It forms in the Netzberg a layer about half a toise thick, which lies under the beforementioned one. No. 54 is a specimen of it, in which is a ball of agate.

Farther down, deep towards the bottom, this stone loses itself gradually into a black, or black-grey trapp, likewise amygdaloid, No. 52, which in some single blocks assumes a greyish-green colour; for instance, No. 53. In these the almond-form mixtures are somewhat rarer than in No. 54, and the agates are seldom so beautifully marked, generally consisting only of calcedony, together with which we sometimes find also calcareous spar. There occurs, yet very seldom, in irregular nodules a glassy, and sometimes coloured fat quartz. At a greater depth, all these mixtures gradually disappear; the name, *amygdaloid*, is no longer applicable, and there remains at length merely pure trapp, which is visible at the Rabenstein, &c. Veins of

of iron, the iron-stone of which is usually accompanied with brown-stone, are found in this trapp, but they are not worked at present.

I now proceed to a closer description of the agate balls themselves, which, specimen No. 55, are found detached, and shall venture to throw out some thoughts concerning their origin.

In the first place, the form of the balls is extremely remarkable; the term *ball* is, properly speaking, an incorrect name for them, but I have hitherto retained it, as it is the most usual. On examining the specimen, No. 55, it will be found, that it comes nearer to the form of an almond, whence may have been derived the name, *almond-stone*, or *amygdaloid*. But these substances vary somewhat in form from an almond; for almonds are always pointed at one end; but the agates are sharpened in the form of a wedge, like the blade of a razor.* The sharp

* Although I have no idea of comparing, and much less of placing the two substances in one class, yet I cannot help quoting a passage, which greatly struck me, from the Miscellaneous Contributions to Physical Geography, part 1. cap. 3. p. 86, Brandenburg near Halle, 1774. It is this; "At some distance from Currure, in the East Indies, is the diamond mine of Lattewar, in which the diamonds are found in a reddish earth, that are often like the blade of a razor, being thick on one side, and quite thin on the other."

sharp end of such an agate-almond is, in its position, always turned, more or less, downwards. The more the longest diameter of such an almond recedes from the vertical line, the flatter do they appear to be pressed down by the superincumbent mountain, so that they lose almost entirely that form, when, as in the case of specimen, No. 56, they come near to the horizontal position, or actually lie in that position. Some few occur, which, according to their longest diameter, are in a full perpendicular position; but they are of the form of a pear, with their points turned downwards.

Now supposing, that heat joined with moisture, and the consequent fermentation had disengaged some sorts of air from the as yet soft mass of the stone, and that these were collected into air-bubbles, which, on account of the density of the fluid mass, could not ascend according to the shortest line of resistance, and burst in the open air, there is nothing more natural than that these air-bubbles should be in the lower part pointed or sharpened, and in the upper round or arched. For, the tendency of the air in a heavy substance, to ascend by the shortest line of resistance produced for itself, according to this direction, in the part of the mass still soft like paste, at the time of its deposition from the water, a sort of arch, which on the subsequent

subsequent hardening of the mass remained, and kept that form. But, whereas the shortest line of resistance in a mountain very seldom coincides with the perpendicular line, it necessarily followed that, in case of an oblique shortest line of resistance, the perpendicular pressure of the superincumbent range should flatten the air-bubbles on one side, and that, in case of the coincidence of the shortest line of resistance with the horizontal line, they should be quite flattened. The former case may be observed in the agate-ball, No. 55 ; the longest diameter extends from the sharpened end to the roundish one, as likewise the shortest line of resistance, yet so, that the sharpening runs horizontally. The latter case occurs in No. 56, in which the shortest line of resistance coincides with the horizontal line, so that the agates, which are found in it, are quite flattened like small longish cakes.

After the air had formed for itself these air-holes, the wet substances occurring in the mountain would naturally be collected in the adjoining cavities ; these were impregnated with acids, and heterogeneous sorts of air, and thereby acquired the power of separating the finer earthy parts from the neighbouring rock.

In proportion to the facility, or difficulty, with which these earthy parts were dissolved, they

they must have afterwards become hard again, and partly crystallized. Thus, for instance, the calcareous earth is that among all sorts of earth, which is most easily and quickly dissolved; consequently it will be the last, after the separation of several sorts of earth, to harden again, to approximate its parts, or, if there be room enough, to crystallize. On this account we sometimes find in hollow agate-balls beautiful crystals of calcareous spar lying on quartz; these crystals are not always of mere calcareous spar, for I have, although very seldom, found some of them to be of ponderous and fluor spar. The calcareous earth of an impure sort, and too closely allied and connected with the earthy parts of the substance of the rock (*gebirgart*), and sometimes ferruginous, has firmly fixed itself, in various manners, to the sides of the bubble-form holes, so that the agates are sometimes covered with a calcareous crust, and accordingly at the surface effervesce with acids. There are sometimes found balls, consisting entirely of calcareous matter, which, when dissolved in a sufficient quantity, had filled up the whole cavity.

After the dissolution of the calcareous earth, that of the pure siliceous earth came on in its turn, in the course of time. But, as it does not dissolve so easily as the calcareous earth, it must accordingly sooner become hard or crystallized. Therefore

Therefore in hollow agate balls the quartz is always found between the real agate and the calcareous spar, or, if there be no calcareous matter, always inside. Sometimes balls are found consisting merely of quartz, which, having been dissolved in sufficient quantity, had filled the entire cavity; when in a smaller quantity, it left the ball hollow, and merely lined the cavities with quartz crystals, which, according as the siliceous earth was more or less impregnated with ironstone, or brownstone, are variously coloured, brown, red, or violet.

The water, from which the siliceous and calcareous earths had been separated by crystallization, must have remained behind in the hollow balls; and on breaking these balls, if as yet undecomposed and uninjured, we actually find it in them.*

Although in this place there can be no discussion about the solubility of argillaceous earth in acids, yet the fine argillaceous earth can be easily united with every watery fluidity, and by their mixture the solubility of the siliceous earth, so nearly allied to it, be prevented, and, viceversa, the more speedy hardening of the siliceous earth be forwarded. This is plainly seen in

* In this manner we can account for the calcedonies with water drops from the Vicentine hills.

in the balls we are now treating of; their external coat is usually of the calcedony kind, or, more properly speaking, a hardened siliceous earth closely mixed with argill, which, also on account of its near affinity with the argillaceous substance of trapp, has uniformly attached itself to it on all sides, and thus hardened in concentric scales. If there was no more argillaceous earth in the solution, which might change the quartz into calcedony, and bring about the more speedy hardening of the siliceous earth, and if this had fixed it firmly all around, the pure siliceous and calcareous earth, separated from the argill, remained behind in a state of solution; it continued in the fluid state, until the time came that it could harden by itself, and crystallize. During this interval, the siliceous earth, now become calcedony, mixed with argill and some calcareous matter, was in a more slimy and gelatinous state than the more pure solution of the siliceous earth. The gelatinous mass of calcedony, which all around in the cavity either was uniformly distributed, or received affluxes from the mountain above, sometimes sank down from above in stalactites; and therefore we sometimes find in the balls stillicidious (*getropften*) calcedony, either insulated, or again coated around with quartz, so that it cannot be discovered in the agate balls, except by a polishing

a polishing parallel with the direction of the stalactites. But where the slimy mass of calcedony was not in sufficient quantity, so as to trickle down in virtue of its own weight, and flow down along the sides, it remained hanging in half-formed drops at the arch of the balls, and hence proceeded the kidney-form figure of the calcedony; perhaps also a certain greater degree of fatness (if I may be allowed to use this word by way of comparison) was the cause of it, owing to which the slimy mass of calcedony could not mix with the more watery fluidity, that still remained in the solution, and a resistance to their uniting took place in the same manner, as we observe on dropping some odd drops of oil into a glass of water. For this reason the quartz, which afterwards became deposited in the kidney form calcedony, is never found so intimately connected with it, but that (particularly after a certain degree of disintegration) it can be separated from it by breaking.

According to what has been stated, the gradations of solution are, 1. Calcareous matter. 2. Quartz. 3. Calcedony: and those of hardening and crystallization are, 1. Calcedony. 2. Quartz, and 3. Calcareous matter.

Serpentine, or Magnesia earth (*Bittersalzerde*), when occurring in the mixture only in a very small quantity, colours merely the outward

ward coat of the ball, and the cavity in which it rested, somewhat green; but it is usually and preferably attached to such balls as consist entirely of calcedony, and in which there is the least admixture of calcareous matter; seldom is it found spread out in greater abundance, as colours use to be spread; I have never observed it in such quantity as to fill one of these cavities by itself.

Sometimes the cavities are entirely, and sometimes only in part, filled with coarse hardened argillaceous earth, exactly of the same sort as the trapp substance, No. 54, in which they are found; and the modes of filling are exceedingly various, according as the wet substances in the air-holes had dissolved, and again deposited, one or other simple earth in a greater or smaller quantity. Thus, for instance, there are balls, in which nothing else is found all through than calcedony, which, when coloured by metallic substances, receives the name of agate; likewise balls are met with, in which calcareous matter is prevalent, and calcedony occurs in a very irregular manner, and as if in nodules.

If there existed in the substance of the rock (*gebirgart*) also metallic parts, they must have been equally brought into a state of solution, when the water collected in the cavities, now containing the agate balls, had separated the
finer

finer simple earths from the mineral, and, I may say, lixiviated them.

In proportion with the more or less phlogistic, or dephlogisticated state, and the consequent greater or lesser solubility of the metallic parts, (which in this case are only ironstone and brownstone) their hardening and crystallization must have succeeded in a suitable series, and accordingly the separation of the metallic parts from the sorts of earth have gone on, in the same manner as, according to the above disquisition on the origin of agates, the calcareous and siliceous earths separate in proportion to their respective solubility.

For example, if the metallic parts were less soluble than the calcareous matter, and more so than the quartz, we must at present, on breaking the agate balls, necessarily find the metallic aggregate hardened between the calcareous matter and the quartz; and thus in almost every agate ball we may observe the gradations of the various solubility of substances.

In the agate balls at Ilfeld, the metallic admixtures are found only in the form of nodules, or kidneys, and sometimes crystallized, but in such regular and concentric scales, as the agate itself. I have found iron in them under different appearances; one time as iron-spar (*eisenspath*), another as scaly iron-ore (*eisenrahm*), another

as white iron-ore (*stahlerz*), another as *eisenmann*, or crystallized iron glance (*eisenglanz*). I have also discovered in them real radiating hematite, which usually appears only at the surface of the agate balls, and sometimes merely as the track of them; then are seen small, round, brown-red points, from the size of a lentil to that of a pea, which usually consist of concentric rings. On breaking the stone, these red points often rise out from the agate balls, and one can plainly see, that they are nothing else than impressed half-balls of a red hematite.

There are sometimes found in the trapp range some small clefts, of the width of one or two lines, which are filled with calcedony substance, and have streaks of onyx. I have seen a similar cleft passing through an agate ball. The calcedony seemed to have again connected it together, after, perhaps on a splitting of the rock, it had been broken along with it. That the rock had been split in several places, appeared from divers agate balls still fast sticking in the mountain, and divided by rock-clefts; but of these balls the one half was not placed exactly towards the other, but was constantly, with respect to it, somewhat sunk and pushed out of its place.

The agate balls stick very fast in the undecomposed trapp; but, as soon as the stone gets somewhat

somewhat into a state of disintegration, they can be easily separated. The ferruginous trapp, No. 54, is very apt to become decomposed, and the stone is, in its small and often scarcely visible clefts, very easily penetrated by corrosive wet substances. These attack also the agate balls sticking in the stone, which, if consisting merely of calcareous spar, are soon destroyed, so that, on breaking the somewhat decomposed trapp rocks, holes are found often quite empty, in which but seldom a little ochreous earth occurs. The balls, which, besides calcareous spar, contain also nodules of calcedony, can lose, by disintegration, only the calcareous spar, while the calcedony, in virtue of its greater power of resistance, remains entire. Hence it is, that in those cavities we often find only fragments of calcedony balls.

Such a flötz, as that of amygdaloid now described, must necessarily appear at the surface in many places; this, however, is a mere chance, when it is perceived in a virgin mountain covered in many places with mound-earth (*damm-erde*). Nor is it to be wondered at, that it shows itself, in places considerably far asunder, under various modifications; one may, notwithstanding, always conclude with a certain degree of probability, that he has found again the same flötz, when in one and the same range there ap-

appears a similar flötz under similar circumstances, although it be somewhat variously modified. This is the case with regard to the agate flötz, which appears at the surface between Walkenried and Weida, under the Langenberg, nearly over the bank of the river Weide.

The Langenberg is a flat hill consisting of a brown sandstone, which, in the general view of the flötz layers at the end of this chapter, is marked the 17th; in the upper part the sandstone becomes more argillaceous, so as to correspond with the 16th flötz-layer; of the 18th, or the stone, Nos. 74 and 75, we find there no trace. Under the brown sandstone is found likewise the agate flötz, not like the amygdaloid of the Netzberg, but as a white clay about three feet thick, of which No. 46 is a specimen. Might not this clay be a decomposed amygdaloid, such as we see in specimen No. 59? I think this amygdaloid wants no considerably greater degree of decomposition to become the white clay, No. 46. In this white clay are found the large balls, or rather nodules of agate from Walkenried.

These large nodules consist of a mixture of quartz, calcedony, and agate, through which sometimes pass brown and red veins of jasper. The opaque, from one to two inches thick, external coats of these large lumps are usually of a peach-

a peach-blossom colour; but on closer examination they are found to consist of fine red and white fibres alternating with each other, which all tend towards the centre of the lump. Within is seen quartz, surrounded with a coat of calcedony, and both are intersected by veins of agate and jasper, which seem to have filled up their clefts. Nature must have had in view wonderful alterations as to these lumps, whereas we find throughout traces of separation and regeneration, which it is not possible to observe in the small stones struck off from them, specimen, No. 45.

There is a tradition, that a flötz of stone-coal has been discovered in that place under the white clay by means of a shaft, the remains of which are still visible; this appears to me very credible, from the position of the stone-coal flötz under the amygdaloid near Ilfeld, whence we may conjecture there is one in this place also. I must here mention a very rare crystallization, which has been found only once in these large nodules of agate, and from which a very beautiful druse is to be seen in the Duke of Brunswick's Museum of Natural History. It is a group of four-sided prismatic crystals, the greatest part of which have internally cavities of the form of a reed, and likewise four-sided. The crystals are but little transparent, and are dull

in the fracture ; I should reckon them among the crystallized hornstones. They are of various lengths, seldom an inch ; their thickness is up to the sixth part of an inch. On their four side-faces are sometimes found very thin tape-like elevations, smaller than the face itself, but always parallel with the figure of one of them, so that it sometimes appears, as if nature had meant to form crystals in the form of a cross. Both the ends of the crystals hold fast in the druse-holes, on which account their form cannot be ascertained.

Among the divers modifications of this flötz of agate is, in all probability, to be reckoned also the substance, No. 92. The matrix of it is, for the most part, calcareous earth, in which the siliceous earth usually appears as calcedony in irregular streaks. It is sometimes so closely connected with ferruginous argillaceous earth, that it passes, as a real red jasper, through the calcareous matrix in similar streaks.

This calcareous matrix appears under various forms ; in one place, as real marble, in another, as a yellowish splintering limestone ; elsewhere, in the nature of calcareous spar, and this last sort, when rubbed and polished, exhibits a curious variety of colours. This sort might, perhaps, be classed with those marbles of Sweden and Siberia, that give fire with steel, and which
Mr.

Mr. Kirwan, in his Mineralogy, under the head of *Limestone with veins of quartz*, calls *Saxum Sahlbergense*.

Just over the village of Sültzhayn, in the county of Hohnstein, there juts out under the substance, No. 75, a flötz of the sort now mentioned. Near under the mound-earth, very large pieces of ten, and more feet in length, are procured, which are used for door-sills and other purposes. The layer of this flötz is almost quite horizontal, and in the same line run also the layers of calcedony, which become visible only in the cross fracture.

Of the flötz of stone-coal I have not been able to make any part discoverable, and yet, in all probability, there must be at least something of it; but that tract is too much covered with mound-earth, and too little opened.

I must touch a little also upon the boulders of the agate kind, which are found in the flötz range at the southern foot of the Hartz mountains; among them the Espenberg, between Ilfeld and Königerode, is particularly remarkable. In a part of it are found quartz, hornstone, jasper, agate, the so called coral agate, and stillicidious calcedony and agate, in abundance. They are found likewise at Walkenried and Sachse, and in the latter place a sort of loose iron-stone (*leseeisenstein*), which used to be gathered

thered off the fields, and melted down at Zerenheerd.

These boulders are usually brought up with the plough from the earth, and it may be conjectured of them also, that they belong to the out-going (*ausgehenden*) of the abovementioned agate flötz. They lie quite under the copper-slate flötz, as appears particularly at Espenberg.

This is all I can say concerning the amygdaloid and agate flötze, to which I have to add, that, deep below, it constantly approaches more and more to pure trapp, after which, next follows a schistose flötz, which forms the covering (a foot and a half thick) of the stone-coal.

The stone-coal flötz is 18 inches thick at Netzwies, under Rabenstein, where it was formerly worked; at Vaterstein, near Neustadt below Hohnstein, where it is still worked, it is in some places up to 30 inches thick. It occurs here according to the manner usual in flötze, that are worked; its fall is towards the hours 9 and 10 to the southward; it has likewise its backs and alternations (*rücken and wechsel*), and very frequently near each other, so that I have found four alternations between two shafts (those of William and Albert), about forty toises asunder. At these alternations there is, for the most part, stone-coal, sometimes a soft and bad stone, and at times a hardened clay; all these substances

stances are sometimes accompanied with copper pyrites.

This stone-coal, with the exception of some small thin streaks of slate, is rather of a uniform nature, and properly belongs to the class of pitch-coal, as it burns without flame; a pure earth-pitch exudes from it in abundance, and in burning emits a bituminous and not disagreeable smell. No. 119 is a specimen of this coal; specific gravity, 1,580.

Under the coal is again a black slate, with impressions of reeds and herbs, 18 inches thick; then black trapp as above, which forms the deadlier of all the flötz layers. This is followed by the vein-range of the Hartz, which here consists of slate and grey-wacke.

For the sake of a more accurate general view, I now proceed to the complete arrangement of all the flötz-layers, that jut out (*ausgehenden*) one after another from Nordhausen to Ilfeld, and farther northwards over Ilfeld.

Lehmann, in his *Essay on the History of the flötz mountains*, has not only described, with sufficient accuracy, this order or series, but has also clearly exhibited it in profile, which delineation will serve to clear up such obscurities as may occur in my description, and to prevent the misconceptions, that might arise from my expression, *under the copper-slate flötz*. For no one will believe, that the stone-

coal flötz lies under that of copper-slate *in one and the same hill*; as their outgoings (*ausgehendes*) are 4500 paces asunder, and several hills lie between them. Accordingly I may give here Lehmann's account of these flötz layers, which is to be found also in Gerhard's History of the Mineral kingdom, almost in his own words, yet with some corrections.

I. Uppermost is mound-earth of various thickness; it is to be looked for on the highest points of the flötz mountains, ex. c. at the Hohnstein and Sachswerferberg; for, in other places it is found much farther behind. (Sandstone, also, is in that tract much farther behind.)

II. Swine-stone of the sort, whose various modifications I have described in the preceding chapter, about six toises thick.

III. Alabaster of very different thickness, from 4, 6, 10, 20, up to 30 toises; as, for instance, at the precipices of the Kohnstein, where it is visible.

IV. Coarse wacke (*rauhwacke*), consisting of sand, clay, and calcareous earth, from 12 to 20 toises thick.

V. Limestone, called *zechstein*; usually two toises thick.

VI. What is called *oberfäule*, that is, argillaceous

laceous earth, mixed with some calcareous matter and sand ; three feet thick.

VII. What is called *ueberschuss*, a thin flötz of potter's clay (*lettenflötz*), about an inch thick.

VIII. Soft rotten substance (*fäule*), consisting of argillaceous earth, mixed with some calcareous matter.

IX. The covering (*dach*), a grey calcareous argillite (*thonschiefer*) with, in some places, black dendrites, 16 inches thick.

X. A very poor copper-slate, called *Mittelberge*, six inches thick ; it is, for the most part, argillaceous earth, but looks as black as the good copper-slate.

XI. *Kamschaale*, a black slate, containing very little copper, an inch thick.

XII. Again, a sort of middle-slate like No. X. four inches thick.

XIII. The best copper-slate in the series, only one inch thick.

XIV. What is called *lier*, or sandy mineral (*sanderz*) ; the surface of the deadlier penetrated with bitumen and metallic (chiefly ochreous) parts, usually not worth smelting for more than an inch of its thickness. Otherwise this is the flötz of the

XV. *Lier*, full three feet thick.

These flötze appear, after removing a little
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the loose earth, almost all at the long wall near Ilefeld.

XVI. Blue clay, from 2, 4, to 8 inches thick.

XVII. The tender dead (*zarte todte*), properly a red sandstone, a toise thick.

XVIII. The red *lier*, a strong red stone; No. 75 of the collection is a specimen of it. Entire mountains, such as the Herzberg and Kaulberg near Ilefeld, are composed of this stone. Veins of ironstone and brownstone run in it, as also in the following substance. The map will shew how far it extends;* it stretches in breadth above half an hour's walk, and it is difficult to determine the huge thickness of this flötz. According to the analogy with other substances of rocks one would take this for the real deadlier, and accordingly for the lowest flötz layer; but the following circumstances prove, that there are under it other layers, and even a flötz of stone-coal.

XIX. A sort of porphyry, somewhat like the preceding, but more corneous, and with some small iron garnets; No. 74 is a specimen of it. It never cuts off sharp from the former.

XX.

* I have not been able to distinguish it, on the map, from the substance, No. 74, and have marked it with the same colour, which I have given to the porphyries.

XX. Amygdaloid, No. 58 of the collection; likewise No. 57.

XXI. Also amygdaloid, with small agate balls somewhat more distinct; specimen, No. 56.

XXII. Brownish-red, liver-colour trapp, with balls of agate; specimen, No. 54.

XXIII. Grey-greenish trapp, with some balls of agate; specimen, No. 53; alternates with the following black trapp.

XXIV. Black trapp, which, in the neighbourhood of the two preceding sorts of stone, contains some small indistinct kernels of agate, that are quite lost at a greater depth; specimen, No. 52.

The sorts of stone mentioned from XX. to XXIV. border so much upon and into each other, that their peculiar limits and thicknesses cannot be assigned. The last one may be computed to be in some places 10 toises thick, while the others, taken together, may be from six to twelve feet.

In conformity with these four or five flötz layers, probably come forth those agate flötze, from which we have at Espenberg, near Walkenried and Sachse, the agate boulders; between Walkenried and Weida, the large agate nodules of the Langenberg; and at Sülzhayn the marble

marble with streaks of calcedony, specimen, No. 92.

XXV. The covering of the coal; a blue argillite, 18 inches thick.

XXVI. The stone, or pitch-coal, 18 inches thick.

XXVII. Black slate, with impressions of reeds and herbs, 18 inches thick.

XXVIII. Black trapp, the proper lie of the coal flötz and all the flötz layers.

XXIX. The vein-range of the Hartz, which here consists of grey-wacke.

From what has been said, it appears very clearly that the copper-slate flötz, and the coal flötz, must have been formed at very different periods; the latter is certainly much older than the former, and the substances lying between them are older by far than those, which cover the copper-slate flötz.

I think now I may be excused for not giving further descriptions of the flötze, which have been sunk through at the foot of the Hartz mountains, as they do not differ essentially from those mentioned, from No. I. to No. XIV. although bearing different names.

I must also pass over several small varieties, which occur singly in these flötz ranges, as it would be impossible to bring them into a connexion

nexion with the whole; as, for instance, the fat argillaceous earth, fit for making tobacco pipes, at the foot of the old castle of Rheinstein—the brick-clay, which is dug up at the foot of the Langeberg, between Harzeburg and Ockerhütte; &c. &c.

CHAPTER

CHAPTER III.

Petrifactions and remains of organized substances, from the flötz mountains.

AS little as I am enabled to arrange in a lithological order the remains of organized substances, that appear in the great and extensive district of the flötz mountains, such an arrangement would be equally little interesting to a great part of my readers. For, all the petrifications and remains of this sort prove directly one and the same thing. They are all indications of the wide sea, which formerly covered a great part of Germany ; and, in examining any of these fossils, it will not be easy to remove the veil, under which lies concealed the secret, whether it has been brought here by the deluge, or whether the North sea and the Baltic have gradually overflowed and raised the tracts, in which we find the flötz ranges with their manifold remains of organized substances. Yet from the great quantity of marine substances, which we find in them, it seems to result, that they

they were indigenous here, and not merely deposited by a passing inundation.

The chief characteristic of the petrifications from the flötz mountains is, that they have all a fresher and less shattered appearance than those from the vein-mountains, and that their being of a later production is easily perceivable. I shall here confine myself to a few remarkable specimens, which have been found in the flötze at the foot of the Hartz mountains; and the shells converted into calcedony, from Platenberg, at the foot of the Regenstein, near Blankenburg, No. 83 of the collection, deserve to be first taken notice of.

The Platenberg is a very flat hill, at the foot of the Regenstein, or Rheinstein. The sandstone, of which it consists, does not appear, at the surface, in the form of rocks; but the celebrated shells of the calcedony kind are found only in boulders of sandstone in the fields, according as they have been ploughed out from time to time. Were the land here not all cultivated, the position of this stone might be more accurately inquired into; but, at present, nothing more precise can be determined. Meanwhile the chief point is reduced to the so often asserted, and as often doubted, conversion of calcareous earth into siliceous earth; and certainly the easiest way to get over the explanation

tion of this singular phenomenon, in which shells, naturally calcareous, are at present of a siliceous kind, would be to admit, that calcareous earth can be converted into siliceous.

In the fifth volume of the writings of the Berlin Society of Naturalists, p. 321, &c. there is a Memoir on this subject, drawn up by Mr. J. C. Fuchs, in which also Mr. Walch's description of it is quoted from Vol. 4, p. 210. Yet I shall venture to give a different explanation of this so remarkable and rare phenomenon, founded on the nature of the stone, that encloses these shells.

The stone itself is a coarse-grained sandstone, whose connecting medium consists of a horn-like mass of calcedony, which often shows itself in the stone in rather regular streaks, and sometimes fills up little clefts that occur in it, and often forms the greatest part of the stone. Had the holes been caused by shells and their impressions, it is not to be wondered at, that they also, as well as the clefts, should be filled with the fluid mass of calcedony. We may explain in this manner the origin of all petrifications. In every real petrification of shells, the calcareous scales of the shell-fish must have been already destroyed, and every piece of this sort, which still contains any part of the unchanged scales, does not merit the name of petrification. Now, whereas in the usual
petrifications

petrifications, in the calcareous mountains, we admit a filling up of the space, where animal scales formerly existed, by calcareous earth, why should we doubt, in the case of a siliceous range, that the space, formerly occupied by shells, not only might have been, but actually has been filled up with siliceous earth? All the echinites, and other scaly animals changed into flint-stone, which I have found in the sand tracts of the principality of Lüneburg, have, in all probability, been produced in this manner.

Were we, indeed, to find in a calcareous range shells changed into calcedony, the conversion of the calcareous scales into siliceous earth might probably be maintained with greater certainty. But we want, as yet, sufficient observations for this purpose; for, hitherto, the substances themselves have been more looked into than the bed where they lay.* I cannot, therefore, as yet
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* It is stated, that turbinites of the calcedony kind have been found at Courtaignon, and in Champagne; but I do not know, and wish to be informed, whether they have been found, as with us, in sand and sandstones, or in some other substance. They are found also near Bourdeaux, but their position is not described with sufficient accuracy so as to know, whether they actually stick in calcareous stones or not.

The shells of the calcedony and flint-stone kind, which are sometimes found in the flint-stones from the chalk hills of France and England, and impressed on them, do not afford

subscribe to that theory, whereas my observations on the specimens, which I have before me, prove any decisive proof, their being still some difference of opinion concerning the origin of these flint-stones. Some persons wish to deduce from them a conversion of calcareous earth into siliceous earth; others on the contrary assert, that the siliceous earth of the flint-stones may be gradually changed into calcareous earth. Should it be laid down, that in the mass, in which those chalk hills had formerly been in a fluid state, siliceous earth likewise might have been contained in a similar state (for in nature it is extremely rare to find a primitive earth quite pure and unmixed), I would be inclined to admit, that, when at length a deposition took place, both the calcareous and siliceous earths separated to a certain degree from each other, and each of them became coagulated by itself; and, whereas the latter was in a smaller proportion in the mass, accordingly it must appear in the chalk hills only in nodules.

The siliceous earth could not possibly separate itself quite pure, and without admitting some calcareous earth; hence the flint-stones contain a certain proportion of calcareous earth, which becomes visible, not only by the artificial decomposition in our laboratories, but likewise by the tedious and natural decomposition of nature. For it is well known, that flint stones, if long exposed to the air, become covered with a chalky coat, which effervesces with acids. But this cannot, by any means, be called a conversion of siliceous into calcareous earth.

Calcareous earth was thus intermixed in the siliceous earth of the flint-stone, but in the fine parts was so enveloped with siliceous earth, that it could not be discovered without decomposition. In the air, which is constantly active in the destruction of stones exposed to it, the siliceous earth of the flint-

prove too clearly, in my opinion, that no conversion has taken place.

When we find at present in sand, washed by the water, shells in which there is no animal, we generally, if not always, find the internal cavities filled with sand. They are usually calcined to a high degree, and in this state were probably our shells also from the Platenberg, that had been buried in the sand. The fluid mass of sand was penetrated by fine siliceous earth dissolved, or, if you choose, by a fluid mass of calcedony; and, according as it hardened, the sand was united with it, as clearly appears from the streaks in the stone. The calcined scales, accordingly, were penetrated by the same mass, and all the cavities of the turbinites were filled with it. By this means the alteration was effected, and the calcareous scales became silice-

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flint-stone was accordingly attacked by its corrosive powers; the calcareous earth, contained in the siliceous earth, was thus disengaged, in consequence of disintegration, and its aerial acid thereby became operative, and now wreaked its vengeance on the siliceous earth, which had for so long a time enveloped its corrosive powers, and kept them in a state of inactivity. The siliceous earth, being now attacked on two sides, viz. by the external air, and by the poison, which it carried in itself, (I mean the aerial acid of the calcareous earth) could not but submit to its fate, while, on the contrary, the calcareous earth, being more homogeneous with the corrosive power of the air, could not suffer so much from it as the siliceous earth.

ous, united with some of the calcareous earth of said scales.

The admixture of the calcareous earth is clearly perceived from this circumstance, that the shells now become siliceous are, by a greater degree of whiteness and opacity, very remarkably distinguished from the remaining more transparent pieces of calcedony, which are found near them, or even in the cavities within the shells. Were the shells filled with sand, the mass of calcedony, soaking through, could do no more than penetrate through the sand, and unite it together in stone. But, if they were not full of sand, but hollow, in that case, supposing a sufficient aperture in the calcined scales, and a sufficient supply of the fluid mass of calcedony, this must have soaked through, or it might have flown in through the little openings or holes, which are often found in calcined shell-scales, and filled up the interior.

That moisture can soak into calcined shells, and penetrate through them, appears from the strong adherence of such shells to the tongue, which shows how apt they are to attract all sorts of moisture. Should then moisture, containing siliceous earth dissolved, be less in a state to insinuate itself into a shell rendered porous by disintegration (*verwitterung*)? This seems to me scarcely credible; and I rather think,

think, that it could filtrate into the interior cavities of a shell, if even there was no hole in it; for I have a specimen before me, in which a small stalactitic cone of calcedony has been formed, and also a similar specimen of a petrified turbinite, in whose inner cavity the calcedony has placed itself in its usual form of nodules, which to me proves the total want of an aperture in the shell-scales, and a weak oozing of the mass of calcedony through the fine pores of the calcined scales. In another specimen lying before me, the inner cavity of a turbinite is overlaid with very fine and neat quartz crystals, and in this case the quite pure siliceous earth alone could filtrate through the shell, within which it has crystallized.

I have also a specimen, in which one half of the turbinite scales is not yet altered, and remains so completely in its calcined state, that it effervesces with acids. The shell was, in all probability, not as yet calcined, when it became enveloped in the sand, that had been passed through by the fluid siliceous earth and a little clay, or, more properly speaking, by the fluid mass of calcedony. Accordingly the fluid siliceous earth could not penetrate into the still hard and uninjured scales, and the calcination of them must have taken place after the hardening of the mass of calcedony, and probably at the
time

time when the stone, of which I am speaking, was exposed to the air and weather. To the same cause, (viz. that, at the time of the hardening of the mass of calcedony, some shells were neither as yet calcined, nor filled with sand) are probably owing the impressions of hollow turbinites, which we find at times in some specimens, in which not only calcination, but likewise total destruction must have preceded the time, at which these stones were exposed to the weather.

I must request the indulgence of those, who have got the collection of specimens, for not having been able to give them, in the manner I wished for, the pieces classed under No. 83, as I have now described them. It was impossible for me to do so, as the ground was not sufficiently opened, and I must be content with having found the pieces necessary for my own instruction, and for giving my opinion on this subject. I hope, however, that those, which they have received, will be sufficient to explain what has been said.

I shall just mention the petrified wood, which is found in the Kiffhäuserberg, merely to refer the reader to Mr. Charpentier's Mineralogical Geography of Electoral Saxony, in which is given a copious description of these remarkable petrifications; for, were I to describe them, I should

should go too far from the foot of the Hartz mountains.

Treating of the petrifications of the sandstone flötz, I must not omit the impressions of leaves, which sometimes occur in the sandstone quarry of the Heydelberg, near Blankenburg. According to the opinion of some mineralogists, they are not to be reckoned among the remains of organic substances of a former world; whereas they think they have observed, that the sandstone, being mixed with clay, and somewhat ferruginous, becomes reduced, in the air, into sand; and that the leaves, that fell from the adjoining hazle trees, were mixed among it, and that afterwards, when removed from the contact of the open air, it hardened again into sandstone. I will leave it to be considered, what grounds there are for this opinion, and how far it is founded on experience and observation; but, as likewise *conchae marinae* and *echinites* are found there, much might be said pro and con.

I pass over the many and divers petrifications, that occur in the calcareous range; but, having said something of the flötz range from the North sea, and the Baltic downwards, I shall merely make mention of the *encrinites*, or lily-stones, partly with pedicles from 8 to 10 inches long,

long, which are found, as great curiosities, four miles (German) to the north of the Hartz.

I have not seen the petrifications of fishes in oolite stones, of which Mr. Schröder speaks, pag. 10 of his book on the Brocken.

In the gypsum range no real petrifications have been found as yet, but there have been met with some not less remarkable calcined remains of a former world ; for example, at Düna, fragments of unknown monstrous large bones of animals, mentioned by Counsellor Michaelis, of Marburg, in the Göttingen Magazine, and other bones, which our osteologists consider as those of two old and one young rhinoceros. See, on this subject, Mr. Hollman's plate and description in the Commentaries of the Göttingen Academy of Sciences for the year 1752 ; part 2.—Göttingen, 1753.

In the mineral museum of Count Von Stolberg-Werningerode are the horns of a stag, which were found in a gypsum quarry, near Werningerode, and are described in the fourth volume of the Papers of the Society of Naturalists of Berlin, page 307.

I must say a few words concerning the impressions of fishes in the flötz of copper-slate. They usually come to light, sprinkled over with pyrites, on splitting the copper-slate, and the impressions appear on both halves. Only seldom
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we find on one half a little elevation of the fish, which causes a depression in the other half; sometimes the scales, tail, and fins, are very clearly marked, and kept up. They all lie on their sides, and somewhat curved, as if they had been endeavouring to rise out of the mud, in which they had sunk, and to catch at the water. Their heads are almost always much distorted by the flat compression, and therefore the mouths are often open.

The fishes are almost all of one sort, and, in fact, the same as the impressions of fishes, mineralized by cinnabar, from Münsterappel, in the county of Greweiler, described by Mr. Colini; they all seem, according to Lehmann's opinion, to belong to the class of fresh water fish. Of undoubted sea fishes, which have indeed been found in other flötz ranges, I have not seen a single specimen among the slates from the foot of the Hartz mountains.

The stone-coal flötz, which lies deep under that of the copper-slate, is not free from remains of organized substances, but both the upper, and particularly the lower part, are often full of impressions of herbs, sedge, and sorts of grass. When the stone-coal flötz under Rabenstein, near Ilfeld, was still worked, there used to be found the most beautiful impressions of herbs and flowers; at present no more of them is to be

be met with. Lehmann mentions the *flores*, *asteris praecocis*, *pyrenaici folio*, *salicis flore luteo*, which were so perceptible, that the impressions of the stamina and apices could be clearly observed on the inner disk.

I shall just mention the leaves and veins of firs, which have become ironstone, from the foot of the Rammelsberg, merely for the sake of a general view, this being not the place to treat of them, as I am now speaking of the substances of the former world; this observation applies also to the wood penetrated by iron, and changed into ironstone, from the Alten-Mann of the inner Rammelsberg, and to the wood incrustated with cement-copper (*cementkupper*), of which I have seen some specimens.

P. S. I well know, that the time is not as yet come for arranging minerals according to their respective ages. The annexed table must, therefore, be considered only as an attempt, which probably may be rectified hereafter, in consequence of further observations on a range of mountains more widely opened.

FINIS.

A T A B L E

EXHIBITING THE SUBSTANCES OF THE HARTZ MOUNTAINS CONSIDERED WITH
REGARD TO THEIR RESPECTIVE AGES.

FUNDAMENTAL OR PRIMITIVE RANGE.

Granite

1. 2. 3. 4. 5. 6. 7. 8. 9. 10.
Substances placed upon it

Simple argillaceous or vein range

In conjunction with Granite, and in itself
Trapp

11. 12. 27. 73. 43.

Schistus

Grey Wacke and Sandstone

Porphyry

Serpentine rock

61. 62.

64. 65

60. 63

66. 37

Simple calcareous range

91. 97. 96. 94. 93. 95. 88.

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80

90. 86. 87. 118. 103.

100. 99. 101. 102. 98.

81.

The older Flötz range

119.

53. 52.

54. 55. 46. 45. 92.

56.

58. 57. 59.

74. 78.

75.

Younger Flötz range:

Copper-slate Flötz

105.

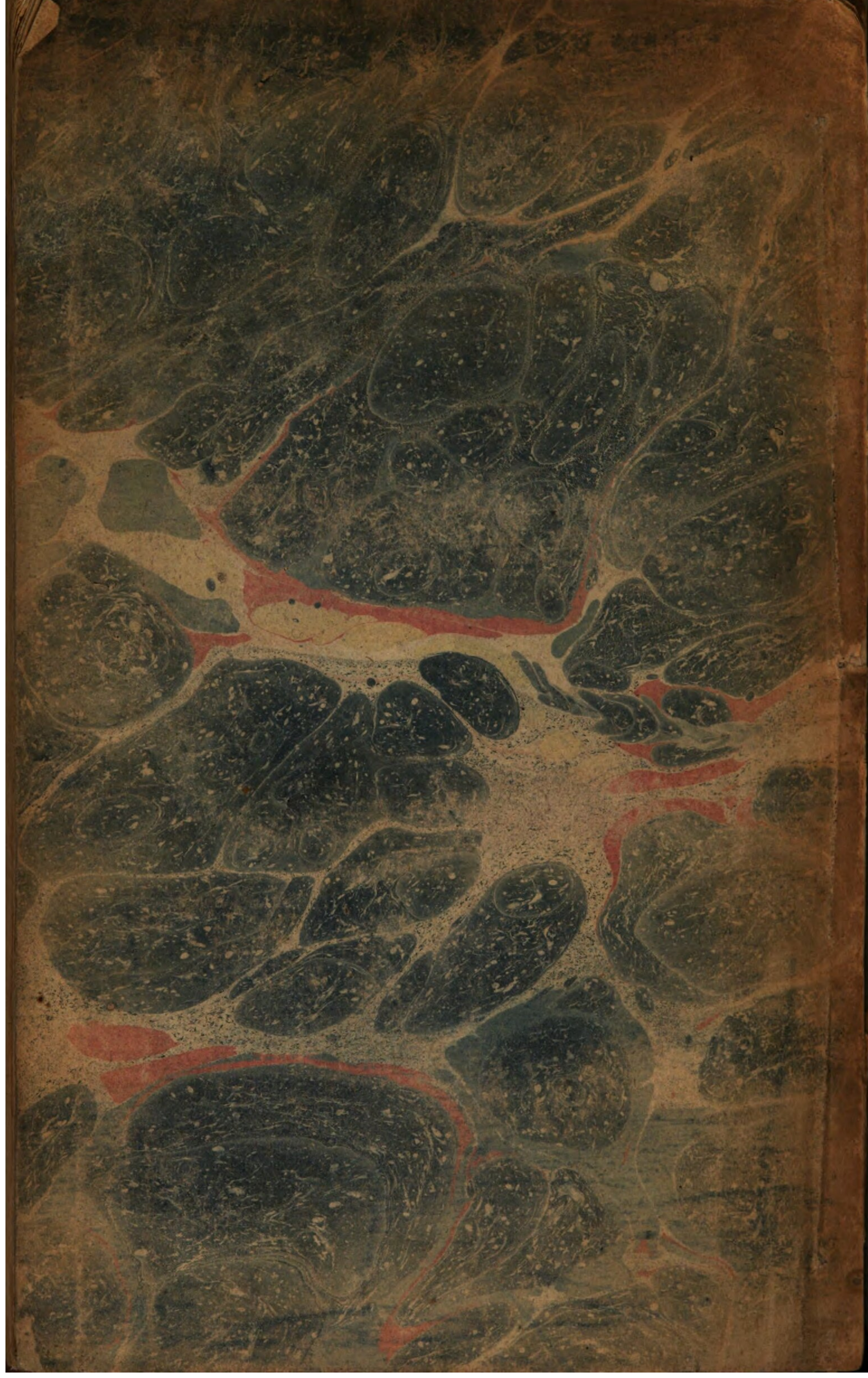
110. 111. 112. 113. 114. 115.

107. 108. 109. 106. 104.

83.

Sorts of Veins (*Gangarten*)

18. 44.



Lasius, Georg Sigismund Otto,

Extracts from Lasius's Observations on the Hartz mountains Sect IV. chap.
III

S.l. [ca. 1760]

Lith. 259 a

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